Universitat de Lleida

TREBALL FINAL DE GRAU

Estudiant: Genís Anaya Ibars

Titulació: Doble Grau en Enginyeria Informàtica i ADE

Títol de Treball Final de Grau: Predictive Analysis applied to talent retention

Director/a: Josep Argelich, Manel Sanromà

Presentació

Mes: Juny

Any: 2019

Aknowledgments

After a long period of time and after many hours of daily work, this has been my collaboration in the People Analytics project, according to my final degree project. From the first day until today, have intervened a high number of people that have helped me in my work and who have made the project a very interesting and didactic experience.

In this way, first of all I would like to thank the University of Lleida for the facilities they have given me to carry out the project jointly with the company. It has been a project that, from the beginning, I considered very interesting and after finished it I have obtained a lot of knowledge through it.

Second, I would also like to thank Stratesys. From the first moment they understood that I was still studying and they have given me all the facilities to be able to combine my work with my studies. When I proposed them to do my university project jointly with the company, they accepted it at once, and together we considered that it was an opportunity for me to continue growing both academically and professionally. I would also like to thank my co-workers who have helped me every day in my doubts and have made the work easier for me. Their experience and knowledge has been supportive for me when I have been blocked and all this has allowed me to continue working and progressing.

Finally, I would like to thank everyone who has helped me during my project implementation.

Thank you all!

Abstract

In this project we explain the design and implementation of a part of an application called “People Analytics” that consists in the analysis of company employees and has the objective of helping the department of Human Resources of any company to prevent the turnover of employees and high performance employees, as well as to get to know the company’s employees better and help decision-making for the management of the department and the company.

The People Analytics application consists in different sections that give different information to different departments of the company. The idea of this project is that every company can manage its information in an interactive and functional way through charts, tables, and graphs that answer all business questions whenever the user needs the information.

In a more specific way, referring the main part of this project, the retention of talent and employee’s turnover, we’re living on a world where companies have understood the importance of attracting talented young people as the main step to develop their business. In addition, companies sometimes look for talent outside the company, ignoring that good training and preparation of current employees can contribute to their growth in the same way.

That is why this tool helps to understand better the employees of the company, to see their concerns and their strengths and help the company managers to make decisions that enhance the quality and the productivity of the company. Moreover, through predictive algorithms and simulations, users of the application can obtain the probability of turnover for each employee of the company and help in each case to act with enough time to prevent the turnover of the employee, and above all, the high-performance turnover.

Contents

List of Figures

List of Tables

1 Introduction

In this section it is explained the motivation and the objectives that have taken me to work in this project with this kind of technology.

1.1. Motivation

Nowadays, we live in a world where Big Data and Machine Learning increasingly have a more important role in business activities and companies are increasingly forced to make a heavy investment in development and technology. In this way, we are entering a world in which a large amount of information is handled and where information begins to answer questions that the companies themselves are unaware of. In addition, companies can take advantage of the information and can identify new opportunities.

Since the growth of Big Data, I have always tried to keep informed about new developments and I have to admit that it's a world that catches my attention and I am sure with myself that after finishing my career I would like to start a project or a career focused on this technology. For my luck, I joined Stratesys in order to do my career practices and it was here where I have been able to carry out my first project related to Big Data and Business Intelligence.

During the realization of this project, I have been able to enter this interesting world and, combining with the knowledge that I have obtained in the university, I have been able to program and learn designing this project that highly represents my double degree. In a more functional way, I have been able to work as If I was the head of Human Resources of a company and see where are the problems with the employees, the reasons that have led to these problems and, finally, to take decisions that affect the Human Resources Department and the rest of the departments of the company.

1.2. Objectives

1.2.1. General Objectives

The main objective of this project has been the design of an application for a company, more specifically, for the Human Resources department, that allows to give a global vision of the employees of the company. Through Predictive Analysis we are able to know the leaving probability for each employee and most important, the leaving probability for high performance employees. Through a visual and intuitive environment, the project allows us to get all kinds of answers to questions that can help to prevent the future turnover of employees and understand each of the employees to know their concerns and their needs.

The analysis of employee's turnover is only a part of a project that aims to help all the departments of the company and combine them through an application that integrates all the information of the company and allows to give a general vision of the business situation. The union of all the factors can help the company in taking decisions, in correcting and preventing future imbalances and in taking advantages of its strengths.

1.2.2. Personal Objectives

For me, this project has been very important because it has been the first project I have designed outside the university. While we are studying in the university, all the projects we design are focused mainly on learning and passing the subject, but when we start working for a company, the responsibilities increase and we have to work focusing on getting the maximum functionality from the project that we are designing and that allow us to obtain a competitive advantage with our business competitors.

In addition, I had the opportunity to start a project with a technology I had never used before, for which reason this has been a challenge and at the same time a motivation for me to learn while designing the project. I think that the experience of working with Big Data and with a tool as intuitive as the SAP Analytics Cloud has helped me to progress and get git more independence in my work.

In summary, before starting the project I had personally fixed the objectives of learning and helping the company to develop a very interesting and functional project, and once it has been completed, I think that all these objectives have been fulfilled and also the project has helped me to take more leadership and responsibility for upcoming projects.

2 State of art

All the technology that is going to be developed through the project can be included in one group that involves all characteristics. This group is one of the biggest SAP modules, and it's called **SAP Business Intelligence.**

2.1. SAP Business Intelligence

Before starting with the project, it's important to start knowing the technology environment that allow us to do all we have done and begin to enter the world on which the project has been developed. In this section we're just going to talk about this module that belongs to SAP, and in other sections we'll talk about SAP in a more general way.

Business Intelligence (BI) is an application used for giving meaning to raw data that an organization has. The raw data is cleansed, stored and applied with business logic to be useful for enterprise users to make better business decisions. This data can be presented in the form of reports and can be displayed in the form of tables, charts, etc. which is efficient and easier to analyze and make business decisions. During all business activities, companies create data about customers, suppliers and internal activities. Based on these data, employees of various departments like Human Resources, Finance, Accounting, Marketing etc. prepare their work plan.

Business Intelligence is a SAP product which majorly focuses on providing its customers/organizations with a user friendly and very useful form of representing data that could be helpful for analysis purpose and making business decisions. In summary, Business Intelligence toots transform raw data into reports which are used for decision making and business forecasting.

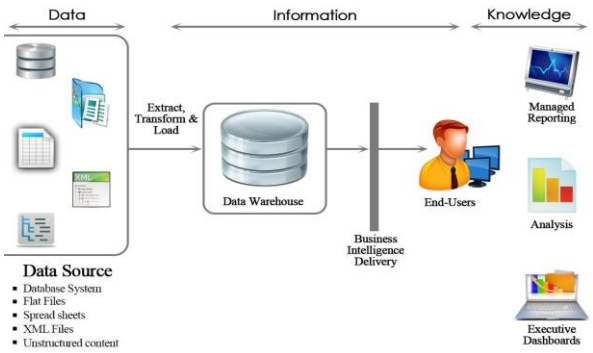


Figure 1: Business Intelligence Architecture

Organizations have different kinds of data such as finance, Human Resource, customer, supplier data etc. which can be stored on different kinds of storage units such as Excel sheets even the company's internal data is often distributed across many different systems and is not particularly well formatted. A Data Warehouse can help to organize the data. It brings together heterogeneous Data Sources which are mostly and differing in their details. Using BI Tools one can derive meaningful reports. This are some points that makes SAP BI more effective BI tool:

- Single point of access to all information is possible through BI. The data from various sources can be accessed at the single place.

- Data collected from various sources are presented in the form of reports which is efficient for analysis of the data at a high level.

- SAP BI provides easy to use GUI (Graphic User Interface) and better formatting.

- Some of the key functionality that makes SAP BI better than rest is its ability to analyze multidimensional data sources in both web and MS office environments, flexible dashboards, mobility and a flexible BI platform.

- SAP BI is known for its awesome query performance, while requiring little administration.

- Mobile BI for end users on the go.

- Easy Integration with other platforms.

As we have said in one of the points above, SAP BI provides easy to use GUI and better formatting. In our project we strengthen this point and we can see how users can easily create data visualizations using interactive dashboards and sophisticated analytic applications through **SAP Analytics Cloud** platform. Through this platform, users can also use predictive models and machine learning to assets the likelihood of future outcomes and steer its business in the right direction.

2.2. Previous Knowledge

One of the main reasons why I started working with SAP it was because I wanted to try and learn something different from what I studied in the university. I knew that after finishing my double degree I could easily start working on a company as a programmer or as an accountant, but I wasn't looking for this. For these reasons, I started my career practices entering to a new world where all was going to be unknown to me but also exciting to start working on a technology that is having a spectacular growth and that every time is more present on the business management.

While I have been working with SAP it's when I started to familiarize with the environment and when I started seeing the potential it offers. Nowadays I'm working with technology and business models that, while I was studying the degree, I couldn't imagine that I would be working on it. Right now, I'm sure that I would like to continue studying about this world and maybe, one day, become an expert about this technology.

Apart from this, I think that there is a lot of knowledge that I have learned in the career that has helped me to develop the different tasks and work my own way to finish getting the result that I want. In this project I have been able to apply all my programming knowledge to design the tools and I have also been able to contribute with my knowledge in business administration for the data and the business use cases of the application.

In summary, I think that this project has helped me to combine the knowledge I had in the career with the new knowledge that has meant for me entering to the world of SAP, exactly on the Business Intelligence and SAP Analytics Cloud environment, and as I said, I expect to continue learning a lot about this world.

2.3. Analysis of the sector

SAP it's the biggest Enterprise Resource Planning that exist nowadays, but the difference between its competitors has decreased in recent days. SAP is still the ERP most used worldwide and pioneer in this world. 24% of users of ERP systems are committed to this comprehensive management program. SAP is designed for all types of companies, especially for small and medium enterprises. The application integrates functions for customers management (CRM), human capital management or financial management, among others. In addition, there's a cloud service so users can connect whatever they want and through any device. SAP uses a very effective technology that allows an effective communication in real time. Following, the main ERP competitors from SAC and also one of the most ERP consumed:

- **Microsoft:** Microsoft Dynamics is a line of ERP and CRM software applications. Microsoft market Dynamics applications, through a network of reselling partners, provide specialized services for businesses. Microsoft Dynamics forms part of "Microsoft Business Solutions" and can be used with other Microsoft programs and services, such as Office 365 and Outlook. Microsoft Dynamics ERP commits to group of enterprise resource planning products aimed at the different market segments and includes as a primary product ERP and CRM as a software solution meant for mid-sized and large enterprises. The solution contains the following modules: Financials and Operations, Sales Enterprise, Marketing, Customer Service, Field Service, Project Service, and Project Service Automation. It is also easily connected with Office 365 and Power BI.

Figure 2: Microsoft Dynamics Logo

- **Oracle:** it's also one of the most user ERP in the world, with almost a 12% of users. This tool offers a wide variety of modules on financial management, sales, purchasing, distribution and logistics, planning, project management or human resources. This company differs from the rest for its business applications, which improve the experience of companies.

Figure 3: Oracle Logo

- **Sage:** this application is intuitive and easy to use. It is characterized by its affordable price and by the package of functions and services it offers, which adapts to the needs and particularities of different types of companies, including those of an international scope.

Figure 4: Sage Logo

- **Infor:** shares position in the market with the previous ERP, Sage, with approximately a 6% of market share. Like all the others, Infor offers multiple features and additional services that improve the user experience. In addition, users can make use of its service in the cloud, to be always connected, and customize it, according to their needs.

Figure 5: Infor Logo

After seeing all the ERP competitors from SAP, let's now focus on the main competitor with the cloud tool. As we said and we can see in next sections, this application has been developed mainly with SAP Analytics Cloud. If we analyze competitors, we see that the tool that offers more competition and is more similar to SAP Analytics Cloud is **Power BI**, from Microsoft. In the following table we can see the differences between both tools about their main characteristics, according to their different types of licenses.

	SAC		POWER BI			
Licenses	**Business Intelligence**	**Planification**	**Free**	**Pro**	**Pro (Office 365 license)**	**Premium**
Price	20€/user	130€/user	0€	8,4 €/user	0€	4.212,3 €/resource
30 users	600 €/month	3.900€/month	0€	252 €/month	0€	
100 users	2.000 €/month	13.000€/month	0€	840 €/month	0€	
Concurrent users	Yes	Yes	-	Yes	Yes	Yes
Capacity	1GB/user	1GB/user	1GB/user	10GB/user	10GB/user	100TB
Private Tenant	*128GB expandable up to 1024GB*			*Data can be updated up to 8 times a day*		
Company Size	Small, medium and large businesses		Medium and large businesses			
Available Devices	Windows, Mac, Web-Based		Windows, Android, iPhone/iPad, Web-Based, Windows Mobile			
Integrations	Delaware Accounts Receivable, COMPAREX Cloud, Seidor, Tech Mahindra Supply Chain Analytics		Microsoft Dynamics, Salesforce, Google Analytics, Microsoft Excel, MailChimp, GitHub, comScore, Adobe Analytics, Acrumatica, Circuit ID, Azure Mobile Management			
Language Supported	English		English			
Features	Data Discovery, Planning, Predictive Analysis, Data Visualization, Role-Based Personalization, Social Collaboration, On-Premise Applications Integration		Customizable dashboards, Datasets, Reports, Navigation pane, Q&A Question Box, Help & feedback buttons, Ad Hoc reporting and analysis, Online Analytical Processing (OLAP), Trend indicators, Interactive reports authoring, Complete reporting & data visualization tools			

Table 1: SAC vs Power BI

3 Stratesys

In this section we are going to talk about Stratesys, the company with which I have developed the project, the company's information and its main market competitors.

3.1. About the company

Stratesys Technology Solutions SL "Stratesys" is a multinational company specialized in digital services that bases its business idea on accompany its clients on their road to the digital transformation and help them achieve their objectives through the development of technological and business solutions. Currently and after 20 years in the market, the company is implementing more than 1000 projects and are a multinational leader in digital services and one of the biggest specialists in SAP and OpenText technologies.

Figure 6: Stratesys Logo

Company identity hallmarks are knowledge, innovation, specialization and quality and with these they help its clients to define, implement and evolve in their technological and digital strategies. The good practiques in company daily work have allowed Stratesys to have numerous awards, recognitions and certifications of which it's necessary to emphasize on: "First SAP expert company with double certification ISO 9001 and ISO/IEC 15504.

Figure 7: SAP ISO/IEC 15504 Certification

Figure 8: SAP ISO 9001 Certification

In addition, another awards and recognitions that the company has are:

SAP Quality Awards	15
SAP EMEA Exoellenoe Awards	2
SAP Innovation Awards	2
SAP Ariba Partnership Award	1
Haokathon de Marketing Digital. Telefónloa (Talentum)	1

Figure 9: Other Stratesys SAP Awards

In order to define the main activity of the company, we can create four big blocks that could define it. These blogs are: **digital, innovation, technology** and **operations**. Here is a small description that will allow us to understand each of its blogs:

- **Digital:** the company understands digital reality and its evolution as a constant in the day of day of the users, brands, companies and societies. A guiding principle with which the company works in all environments, sectors and markets. The base of its work is:

    - Understand and empathize with the **digital user** through different methodologies.
    - Create suitable and valuable **experiences**.
    - Design and implement effective **digital strategies** that are able to activate audiences and impulse the business models of our partners and clients.

Figure 10: Stratesys Digitalization

Through a Digital Experience Area with expert programmers and more than twenty different technologies, the company keeps it in mind that no project is impossible and they are in charge of making every one of the proposals come true.

- **Innovation:** Stratesys R+D team researches and applies the newest and most innovative technologies to help its clients improve their results and prepare for the future. Through the Innovation Agency, the company improves the interaction among **people, technology** and **strategy**.

  For this to be possible and always under a scope oriented to innovation and service quality to business, they merge emerging technologies with disruptive concepts and they rely on Lean Innovation methodologies, which allows them to optimize and accelerate the activity development (avoiding redundancies and non-critical routes) and generate more value through the continuous interaction with its clients.

  The company believes in the need of putting **technology at the service of the business**. In this context, they improve the IT areas and departments of its clients, transforming the corporate IT Service units into business accelerations levers. In order to carry out enterprise projects of new technological developments, the company works with Industry 4.0, Machine Learning, AI, APIs, Robotics and Blockchain.

- **Technology:** this might be the largest and the most important block within the company. In this block, we can divide the technologies in multiple sections:

  - **Business Analytics:** Stratesys focuses in modeling, design and implementation of solutions aimed at measuring the performance, strategy compliance and decision making in the organizations. To make this possible for their clients, the company has consultants who are specialized in orienting organizations to data culture (Data Driven Company), through technology and innovative processes, of the Analytics field, that favor the operative improvement in business decisions. Many of the projects and services in which this area is working are Dashboards, Corporate reporting, Data Discovery, Planning and Budgeting, Financial and Management Consolidation…

- **Enterprise Information Management:** the company helps organizations optimize the management of their non-structured information to enable their processes adaptation to the new digital paradigm. Their objective is empowering the business with the most extensive amount of information for decision making, increasing productivity through the implementation of paper-free process and reducing operational costs through the reutilization, collaboration and safe accessibility to contents in digital format and from any application. Many of the projects and services in which this area is working are Contract Automation, Vendor invoices automation, Legal information digital management, Multi-channel digital communication…

- **Big Data / SAP Hana:** Stratesys works with organizations analyzing all information (structured or not) that allows to expand and deepen the knowledge that clients have of their own business. They identify information, not evident on the surface, of the behavior of their clients, their products and services, and their employees. The result of this analysis is compared with the market and the environment, allowing us to obtain competitive advantages of significant relevance for clients. Many of the projects and services in which this area is working are Text Analysis focused on marketing and social media, Migration/Integration to SAP HANA of NOT SAP databases (as Oracle, SQL Server, MongoDB, Cassandra, etc.), Big Data projects with integration of Hadoop, Spark, MapReduce, Hive...

- **Technology & Development:** the company empowers their clients so they can differentiate themselves from competitors through the implementation of unique business solutions. They also facilitate the interconnections among companies and between companies and people by providing all these services with their own team of experts under a technological innovation outlook that allows them to access any system from any place and any platform. Many of the projects and services in which this area is working are Technological consulting, Support and system maintenance, Integration of SAP and non-SAP solutions…

- **SAP Basis:** SAP Basis support services are a fundamental corner store to ensure the correct performance of any system, since this area represents the “heart” of a SAP platform. They work and care for their clients’ systems, supplying them with additional

security and accompanying their decisions in this key field for the business continuity. Many of the projects and services in which this area is working are new products installation, Platform and operative system migration, Upgrades if SAP products, Data Center Migration…

- **Operations**: finally, this block of the company focuses in support centers and security. These are the sections from this block:

  - **Application Management (AM)**: the objective of its Application Management services is aligning the system management of its clients, with their business requirements increasing their value in a sustainable way and under a flexibility scheme, both in the budgetary and executive levels. The company has **SAP Support Centers** in all their offices.

  - **Business Process Outsourcing (BPO)**: BPO services allow its clients to externalize full support cycles to processes, enabling cost reduction according to models of variable cost, improving the efficiency and quality of the operations, as well as the value contribution. The company provides service to several areas including Human Resources, Finance, Purchase and Treasury.

  - **Cybersecurity:** in the complex present scenario, critical data of organizations compromises one of their more important assets. The capacity of defining and managing technological models that guarantee both and effective response to threats and business continuity, become the fastest road to building digital organizations. Stratesys' services customize the security of the systems through good technical practices, adapting them to each business model: global vision, security, integrity, cost reduction, people, confidentiality and availability.

  - **Cloud Infrastructure:** through partner BESH, the company offers Hosting, Housing and added value services on infrastructure for the business market. BESH has the widest solutions and resources portfolio in the market, reinforced by the development customer-centric services, to guide clients in their path of IT infrastructure as a service.

3.2. Sectors

Since its creation, the company's growth has allowed them offering presence in most sectors of the market. Stratesys estimates that their growth in this last year has been of nearly 300%, with more than 1000 projects and with 66 million S of revenue.

Figure 11: Stratesys Business Sectors

This growth that the company has kept in recent years have allowed us to find Stratesys name in the following sectors to whom Stratesys offers innovative solutions, always adapted to the specific requirements of each industry, as well as a high level of specialization and professionalism of each work team:

- Telecommunications
- Energy
- Construction
- Consumer Goods
- Retail
- Transport
- Life Sciences
- Banking
- Health
- Tourism

3.3. World-wide Technology Services Provider

If in the previous section we talked about the growth of the company in the different sectors of the market, this growth wouldn't be understood without the increase of the geographical presence of the company for all the continents. Currently, Stratesys offers its business services in more than 60 countries distributed from all over the world, where we can highlight many countries and localizations from Europe (Spain and Portugal), United States of America, Latin America (Brasil, Chile, Colombia and Mexico) and Asia (China).

Figure 12: Stratesys Countries

3.4. Competitors

The number of competitors of the company has increased because more companies working with SAP technologies are increasingly. We could name a lot of companies, but I've chosen those ones who are more similar with Stratesys according its company size and the kind of services they offer.

3.4.1. Indra

Indra is one of the leading global technology and consulting companies and one of the technological partners for core business operations of its customers world-wide. It's a world-leader in providing proprietary solutions in specific segments in Transport and Defense markets, and leading firm in Digital Transformation Consultancy and Information Technologies in Spain and Latin America.

Its business model is based on a comprehensive of proprietary products, with a high-value focus and with a high innovation component. In the 2018 financial year, Indra achieved revenue of 3.104 billion €, with 43000 employees, a local presence in 46 countries and business operations in over 140 countries.

The purpose and the new values defined for Indra are what identify the company. “At the core” is the concept that is presented together with Indra, since it defines and reflects its strategic evolution. The new values that identify and guide Indra are:

- **Leadership:** generating real impact through tangible results.
- **Flexibility:** enhancing proximity to the costumer and differentiating Indra from its competitors.
- **Focus:** projecting progress in a clear direction, which is crucial in the specialization of business.
- **Reliability:** building trust and long-term relationships based on experience and excellence.

Figure 13: Indra Logo

3.4.2. Everis

Everis is an NTT DATA Company, dedicated to consulting and outsourcing in all sectors, with a turnover of 1.17 billion € in the last financial year. Everis is a big company with 21.000 professionals across Europe, USA and Latin America. In 2014 Everis joined NTT DATA Group, the sixth-largest IT services company in the world with 100.000 professionals and with offices in Asia-Pacific, the Middle East, Europe, Latin America and North America.

Above all, Everis believes in its people, their ongoing development and their talent. They are firmly committed to talent and its main goal is to nurture high performing professionals by creating an environment of responsible freedom.

Figure 14: Everis Logo

We can divide Everis business idea in these 5 blocks:

- **Disruption:** Everys support its clients to improve their business results by taking advantage of disruption and adding value through new ecosystems, service models and solutions. From an innovation center called NextGen, they focus on the disruption of the business world as a result of advancing technologies. NextGen provides the next generation of technology through innovative and disruptive initiatives.

- **Consulting:** Everys consultancy helps companies excel by improving their day-to-day operations and management. Company propositions align business objectives to the digital revolution enabling companies in the 21st century to differentiate in an increasingly volatile market. Growth and Excellence are the strategies that define company business objectives in consultancy in the digital age. They include specialized services that provide real, flexible and sustainable solutions.

- **Transformation:** the company reinvents technology platforms to incorporate successful innovations, always with the end-customer in mind. They humanize the experience and create new processes that evolve the relationship with people and objects.

- **Technology:** Everis uses the best business solutions to optimize customer relations and internal processes, while maximizing profits. They combine these solutions with the latest technology to provide the best solution for every business challenge.

- **Operations:** to help its clients focus on their core business and strategic initiatives, Everis offers Managed Services. They deliver and maximize business supporting functions (systems and IT related functions) through innovative and efficient technology solutions.

3.4.3. Accenture

Accenture solves client's toughest challenges by providing unmatched services in strategy, consulting, digital, technology and operations. They partner with more than three-quarters of the Fortune Global 500, driving innovation to improve the way the world works and lives. With expertise across more than 40 industries and all business functions, they deliver transformational outcomes for a demanding new digital world.

Figure 15: Accenture Logo

We can divide Accenture business idea in 5 different blocks:

- **Strategy:** to remain competitively agile in a world dominated by change, the C-suite (a cluster of a corporation's most important senior executives) must keep the core running while simultaneously identifying and investing in the new. Grounded in deep industry expertise and analytics, and delivered with the accretive value of human insights, Accenture Strategy enables leaders to act with speed and confidence setting the stage for its clients to not just survive but thrive in the now, the new and the unknown.

- **Consultancy:** Accenture consultants apply innovation to unlock trapped value within organizations, helping embracing disruption to lead in the future. Through research, incubation, prototyping and more, Accenture partners help to connect the dots and reinvigorate business for long-term success.

- **Digital:** they help clients pivot from thinking digital thinking to being digital at the core from interactive experiences that captive customers. This digitalization will be applied through interactive experiences that captivate customers, new intelligence that is applied across every industry, function and process, and the Digital Reinvention of Industry through smart, connected, products, services, plants and workers.

- **Technology:** Accenture Technology powers digital transformation through services designed to reinvent your application portfolio and a new style of IT. They combine business and industry insights with innovative technology to drive growth for business.

Operations: Accenture helps clients to transform their operations, to harness talent, data and intelligence, to deliver the right information where and when it's needed, so they can See More, Do More and Be More.

4 SAP

Once we have talked about our company, it's time to introduce the main technology with which the project has been developed, **SAP**. In next sections we talk about this multination and we will see in detail the main functionalities of the SAP Analytics Cloud.

4.1. About the company

Systems Applications & Products in Data Processing "SAP" is a German multinational software corporation that makes enterprise software to manage business operations and customer relations. SAP is the market leader in enterprise application software, helping companies of all sizes and in all industries run at their best: 77% of the world's transaction revenue touches an SAP system. Its Machine Learning. Internet of Things (IoT) and advanced analytics technologies help turn customers' businesses into intelligent enterprises. Their end-to-end suite of applications and services enables its customers to operate profitably, adapt continuously, and make a difference. With a global network of customers, partners, employees, and thought leaders, SAP helps the world run better and improve people's lives.

Figure 16: SAP Logo

In 1972, five entrepreneurs in Germany had a vision for the business potential of technology. Starting with one customer and a handful of employees, SAP set out on a path that would not only transform the world of information technology, but also forever alter the way companies do business. Now 47 years, more than ever, SAP is fueled by the pioneering spirit that inspired its founders to continually transform the IT industry.

This leadership can be shown by company numbers. Currently, SAP offers services to 425.000 customers in more than 180 countries, has more than 96.000 employees from more than 140 countries, provides software to more than 18.000 SAP partner companies, reached a total revenue of 24,74 billion € in the 2018, has 186 million of subscribers in their cloud user base and has more than 100 innovation and development centers.

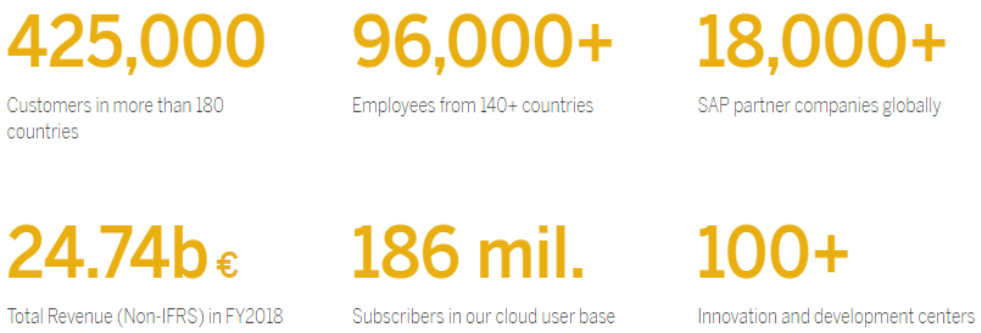


Figure 17: SAP Busines Numbers (I)

4.2. Why SAP?

If we say that SAP has more than 18.300 partners worldwide, the 91% of Forbes Global 2000 are SAP Customers and 171 million cloud users leverage SAP solutions in 180 countries it's because SAP is recognized as a leader across all categories. The best business software meets today's needs and allows for future growth without costly integration. SAP it's recognized a Leader across its portfolio, where we can find these kinds of business software:

- **ERP and Digital Core:** Nucleus Research names SAP a Leader in their latest ERP Technology Value, Matrix citing functionality, usability, and continual expansion of intelligent ERP capabilities in SAP S/4HANA and SAP S/4HANA Cloud.

- **CRM and Customer Experience:** Forrester names SAP Commerce Cloud a B2B and B2C Commerce Leader, saying it's a "best fit for firms looking for an industrial-strength, fully functional commerce platform".

- **Analytics:** SAP Analytics Cloud is positioned as a trusted, transformational tool for cloud-based business intelligence and analytics platforms.

- **HR and People Engagement:** 2018 analyst reports place SAP SuccessFactors solutions as a leader in employee engagement, as well as core HR functions.

- **Digital Supply Chain:** SAP named a leader for Supply Chain Planning System of Record, with a built-in-game changers like AI and IoT.

- **Network and Spend Management:** SAP Ariba is in the leader quadrant for Strategic Sourcing Application Suites and Procure-to-Pay Suites.

- **Finance:** SAP is a Magic Quadrant Visionary in Cloud Financial Planning and Analysis Solutions for analytics, deployment and expertise.

- **Digital Platform:** SAP Hana is a leader in Translytical Data Platforms that "supports many use cases"

- **Intelligent Technologies:** SAP Leonardo was cited as a leader and noted for encompassing IoT "as well as other digital innovation technologies".

The key benefits from having this portfolio are:

- **Rock-solid data security:** one of the first companies in the world to receive global certification from the British Standards Institute, SAP ensures that consumers' privacy rights are protected.

- **Top tier partnerships:** SAP has chosen a collaborative, multi cloud strategy that puts customers first but partnering hyperscalers including Microsoft, Alibaba, Amazon, Google, IBM and other leaders.

- **The only truly integrated software system:** with intelligence embedded in technologies, processes, and applications, their advanced software system provides all customer needs to run an intelligent enterprise.

After seeing this information, we could think that SAP only provides software for large enterprise, but this is wrong because currently the 80% of SAP customers are small and mid-size business. They help its customers automate routine tasks, create tighter connections with their customers, and accomplish more with less. They help to discover right-sized tools and strategies, designed specifically for growing businesses.

In addition, SAP has gained over 45 years of experience working with companies around the globe, helping them to get the most benefit from intelligent technologies by deploying them in context of its specific industry.

Figure 18: SAP Business Numbers (II)

4.3. SAP Analytics Cloud

SAP Analytics Cloud is a single solution for business intelligence and collaborative planning, enhanced with the power of predictive analytics and machine learning technology. SAP Analytics cloud delivers all the analytics capabilities you need (Business Intelligence "BI", planning and predictive analytics) in a single solution. Harness the latest technologies and give everyone in each organization the ability to discover actionable insights in real time.

The SAP Analytics Cloud solution helps you move toward becoming and intelligent enterprise. It offers all analytics for all users on one platform, in one user experience. In the boardroom, at the office, or with a customer, you can discover, analyze, plan, predict and collaborate to make complete, contextual and confident decisions. Users can access all data, semantics, and business logic on their own, to turn formerly hidden insights into the well-advised actions that enhance business outcomes. SAP objectives for SAP Analytics cloud are:

- Become a 21st-century intelligent enterprise.
- Move beyond spreadsheet-based analytics and planning.
- Offer immediate insight users can trust.
- Capitalize on collaborative planning and predictive analytics.

Implementing SAP Analytics Cloud in your business has many Key Benefits that we can summarize in these 3 groups:

- **Reimagined visibility:** achieve unparalleled transparency and the ability to align business planning with execution through the unique intersection of collaborative planning, machine learning and advanced analytical capabilities.

- **Insights beyond human bias:** get deeper insights with less effort with augmented analytics. Respond to natural language queries, automatically analyzed data, run simulations and predict future events.

- **Fast, confident decisions:** act decisively with rich, contextual information, Machine Learning and an industry leading enterprise data foundation. Delivers the right insight, at the right place, at the right time.

4.3.1. Features

SAP Analytics Cloud capabilities are built on SAP Cloud Platform, powered by the in-memory technology of SAP Hana, and can be extended to any device. The main features we can find in SAP Analytics Cloud platform are Artificial Intelligence & Predictive Analytics, Business Intelligence (BI) and Collaborative Enterprise Planning.

Figure 19: SAP Analytics Cloud Features

4.3.1.1. Artificial Intelligence & Predictive Analytics

SAP Analytics Cloud enables to surface previously unseen insights with the machine learning, simplifying access to critical information with Natural Language Processing and easily model complex scenarios with powerful predictive capabilities.

- **Build predictive models with Smart Predictive:** enables to empower business users to create predictive models and integrate them into their business intelligence and planning workflows while no data science experience is required.

- **Perform guided analysis with Smart Discovery:** you can discover the key influencers behind business critical KPIs and run powerful simulations. With auto-generated dashboards, users can instantly gain decision-making clarity and take action.

- **Improve data models with Smart Transformations:** the platform automates repetitive data preparation workflows and enhance data models faster than ever. Using suggestions from Smart Transformations, users can rapidly clean and prepare data.

- **Create an insight-driven culture:** enables to get fast access to business information, generate visualizations on the fly, and explore data in stories.

- **Explore data nuances with Smart Insights:** the idea of this tool is to uncover contributing factors to data points using natural language and visual explanations. Users can quickly develop a clear understanding of even the most complex aspects of their data.

- **Gather similar data points with Smart Grouping:** users can create clusters of comparable data points automatically to identify customer groups, perform behavioral segmentation and categorize inventory based on the parameters specified.

Figure 20: Artificial Intelligence & Predictive Analytics Feature

4.3.1.2. Business Intelligence (BI)

Users can get the answers they need exploring information from across the organization with intuitive self-service features, and deliver insights to stakeholders, at the point of decision, with dynamic interactive stories.

- **Access on-premise and cloud data:** data connectors provide hybrid data access to most critical real-time data sources across all lines of business, including SAP Business Warehouse, SAP Hana, SAP S/4HANA and non-SAP applications.

- **Use embedded analytics:** users can take advantage of extensive self-service business intelligence capabilities, embedded Big Data analytics features, ad-hoc reporting, and what-if analysis, all built into the application.

- **Explore, discover, visualize and communicate data:** Business Reporting has never been the same: filter and drill into data regardless of the size of data volumes. Users can inspire its audience with interactive visualizations and stories.

- **Discuss and share insights in context:** built-in social collaboration tools help users intuitively work and share information with others with no need to switch to another application.

Figure 21: Business Intelligence Feature

4.3.1.3. Collaborative Enterprise Planning

Users can optimize core financial and operational planning, and seamlessly shift plans into action. This feature allows users to design better, more dynamic business models with integrated workflows, supported by rich unbiased-insights, and predictive simulations.

- **Run advanced analyses across your business:** users can create and modify versions of their planning models for data driven budgeting, forecasting and analysis (all from one cloud) based interface.

- **Understand your business, today and tomorrow:** the tool allows creating smart plans for client's entire organization with predictive forecasting and machine learning tools and include visual performance metrics in reports.

- **Support collaborative enterprise planning:** there is facilitate continuous collaboration so users can discuss and align plans in context and set unique permissions to control access sensitive data.

- **Integrate financial planning and analysis:** users can harness a single platform for SAP S/4HANA that combines transactions, analytics and planning, so users can act in the moment and spend more time on strategy.

Figure 22: Planning Feature

4.3.2. Data Modeling in SAP Analytics Cloud

Once we have introduced SAP Analytics Cloud and its main features, it's time to get started and show how do we prepare our data and how we upload and save the data to the cloud.

Data Modeling in SAP Analytics Cloud is a way to enhance your data and prepare it for analysis. Users can bulk edit data, define categories and set hierarchical relationships, and create custom formulas. SAP Analytics Cloud's business intelligence function has two main components:

- **Models:** are where you do all your data modeling in preparation for analysis. Data modeling entails data wrangling, or cleaning the dataset, defining **measures** and **dimensions**, and enhancing data by establishing hierarchies, setting units and currencies, and adding formulas. As we said, models in SAP Analytics Cloud contain rows and columns of data, and every column in a model is defined as a dimension or a measure. These are the main differences between both:

    - **Measure:** are numerical values that mathematical functions work on. For example, a sales revenue column is a measure because you can find out a total or average the data. However, not all columns containing numerical data are considered measures. A satisfaction rating, for example, makes more sense as a dimension.

    - **Dimensions:** are qualitative and do not a total sum. For example, a sales region, employee, location, or date are dimensions.

When dimensions and measures work together, they help answer complex business questions. For example, let's take a look at the visualizations shown in the charts below.

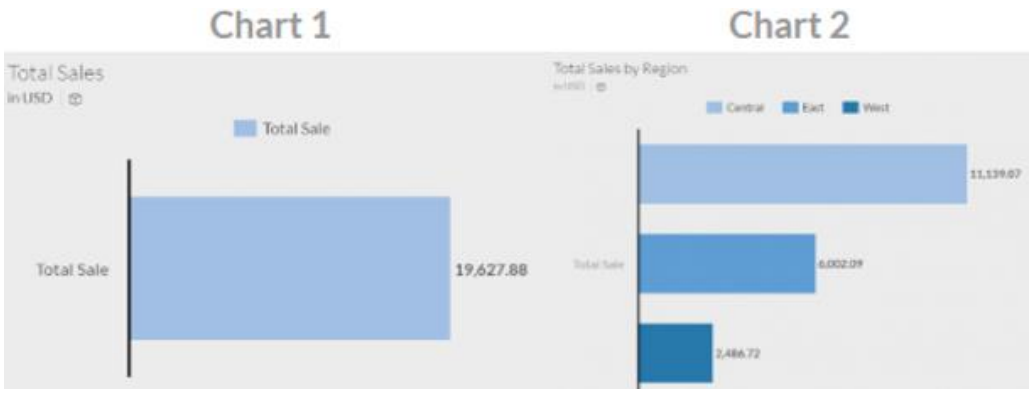


Figure 23: SAC Charts Visualization

Chart 1 displays a single measure, in this case "revenue". The visualization only answers one question: how much profit did we make? Chart 2 displays the measure "revenue" in relation to the dimension "region" to show profits by region. Exploring profits by region will help answer questions about regional performance.

- **Stories:** are where data comes to life. In Story mode, you can visualize data with charts and graphs, giving you an entirely new way to look at your data and gain valuable insight about your business.

Let's start the process of creating a Model. Once you have logged in with your own user, you are on the main screen. To create a model, go to 'Create' > 'Model' from the menu and users get to the following screen, where there have the different options to connect their data into the application.

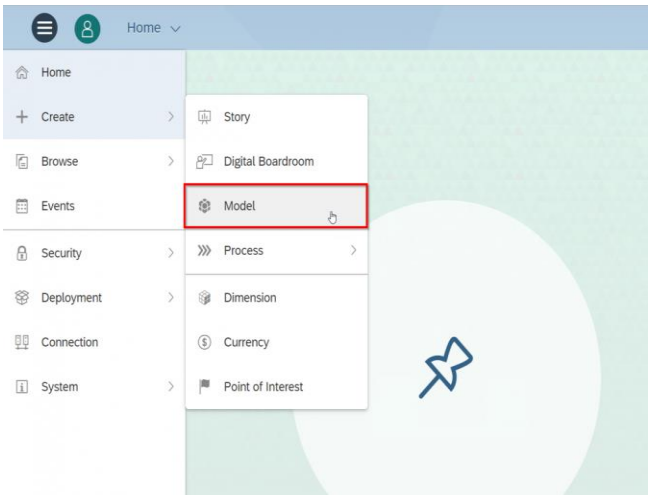


Figure 24: SAC Home Screen

First, we can import data from a file from our computer using a *.csv* or *.xlsx* file. We can also start a model by using a data source like OData, SAP BW, SAP ERP, SQL Databases… and the last way to import data is getting data from an app like Google Drive, SuccessFactors, Salesforce, Concur... In this case, we show how to create a model by importing a file from our computer.

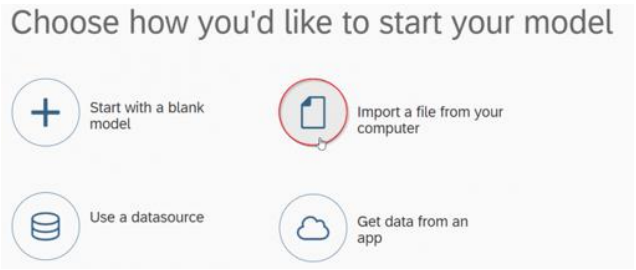


Figure 25: SAC Create Model Screen

While users can skip data modeling altogether and head straight into Store mode, there are some benefits to taking some time in Modeler. If you want to quickly see what your data would like in a chart, then you may want to go to Story mode right away. However, when you start in Modeler view, you can really enhance your stories with data modeling. Once you're in Modeler, your screen will look something like this.

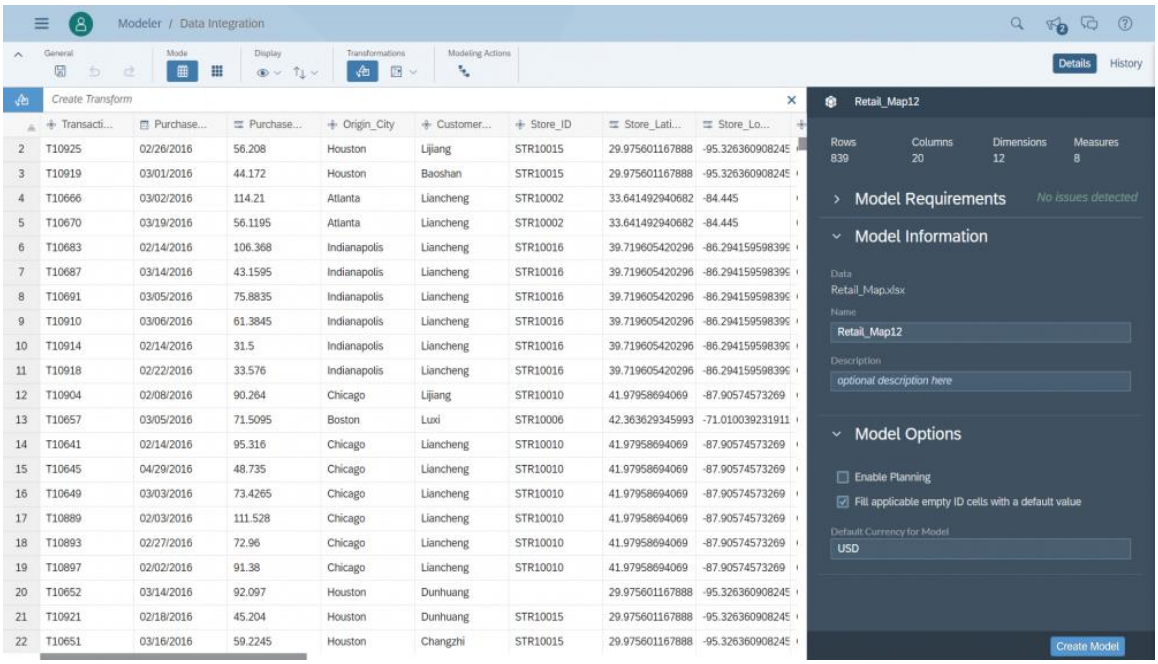


Figure 26: SAC Data Integration

The modeler displays data in rows and columns, tabs, and has various tools for users to transform data. Next, we show the basics of data modeling and some of the more common uses of the Modeler, such as:

- Data wrangling
- Find and replace / Combine
- Splitting columns
- Setting units and currencies
- Creating hierarchies
- Adding formulas
- Geo enriching data

4.3.2.1. Data Wrangling

Often when we capture data, there are inaccuracies, which can affect analysis. For instance, perhaps user dates may be in different formats, or there's typos, and so on. So, before users begin their analysis, they'll want to ensure their data is wrangled properly.

In the example below, we have the same location spelled two different ways, i.e. 'LA' and 'Los Angeles'. Obviously, we need to fix this. We can do this easily with the Find and Replace feature.

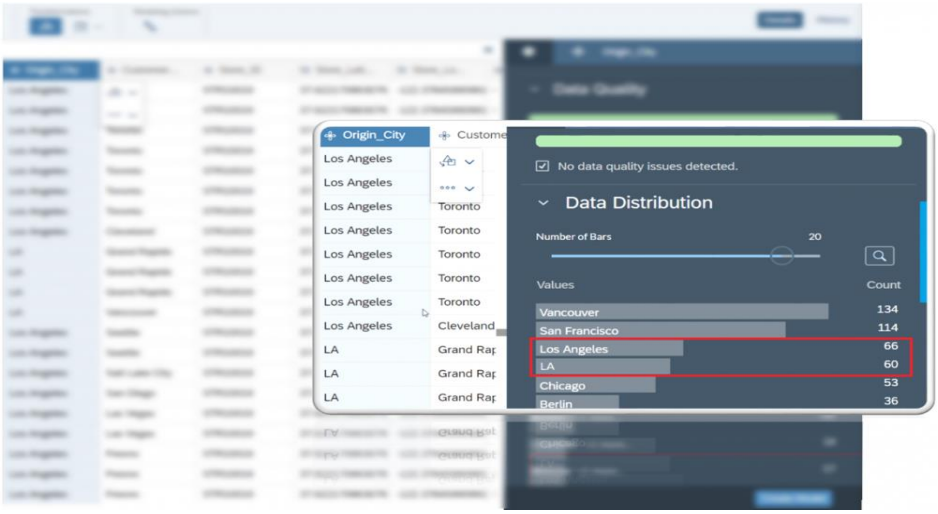


Figure 27: SAC Data Wrangling

4.3.2.2. Find and replace / Combine

From the previous example, we want to combine 'LA' with 'Los Angeles'. First, we need to find all instances of 'LA' and replace it with 'Los Angeles'. However, since LA was treated as a separate place, changing the name won't combine it with the existing Los Angeles data. For that, we need to combine the two sets of Los Angeles data. We can select any of the instances of Los Angeles, click the transform tool, and combine it with the other Los Angeles Data.

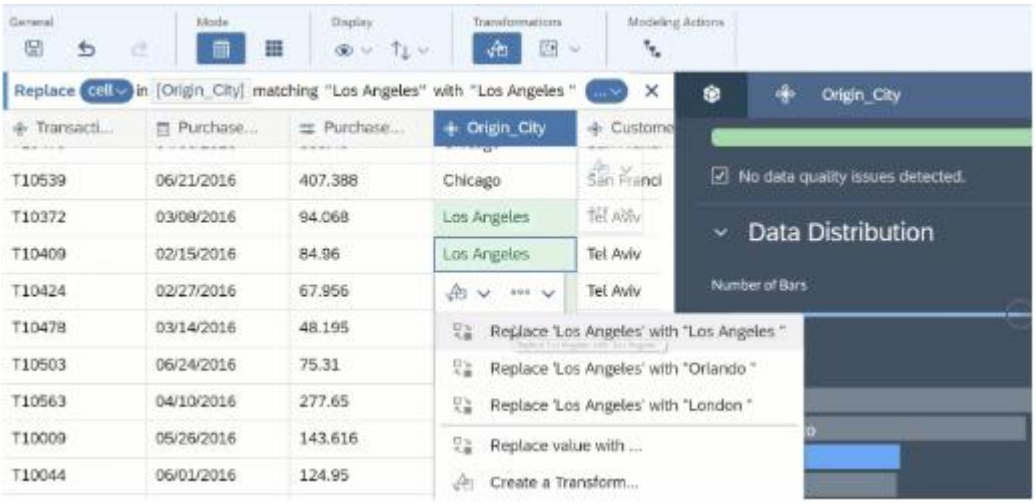


Figure 28: SAC Find and Replace

4.3.2.3. Splitting Columns

Next, we have a category that defines the city and the state. However, we want to split this into two separate dimensions. We can do this easily with the splitting feature by the following steps:

1. Select the column we want to split.
2. Click on one of the split options. This allows the user to create new columns that are separated by spaces, dashes, commas, etc.

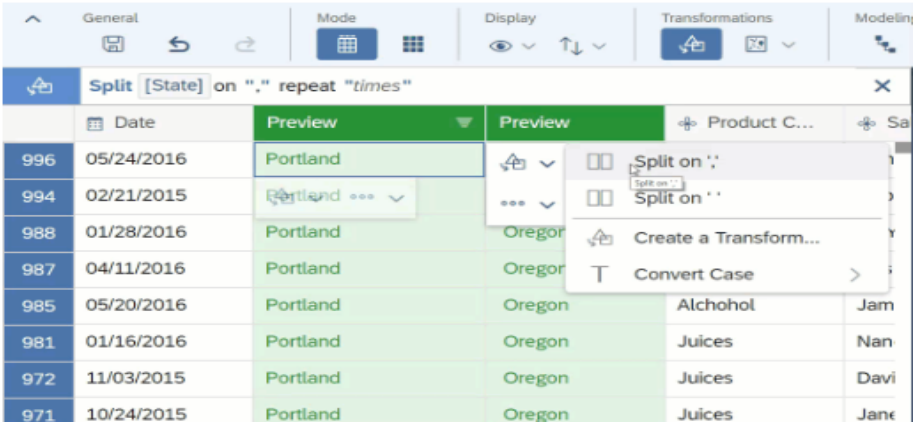


Figure 29: SAC Split Columns

4.3.2.4. Setting units and currencies

Units & Currencies allows you to set the value type and display units. Users can select one of the following from the list:

- **Blank:** no unit will be specified.
- **Label:** users can enter a text label up to 30 characters in length to define their own display units. This can be a unit of measure or a packaging unit such as ‘Bottles’.
- **%:** the percentage option displays the percentage symbol after the value
- **Currency:** this option is used for all monetary values

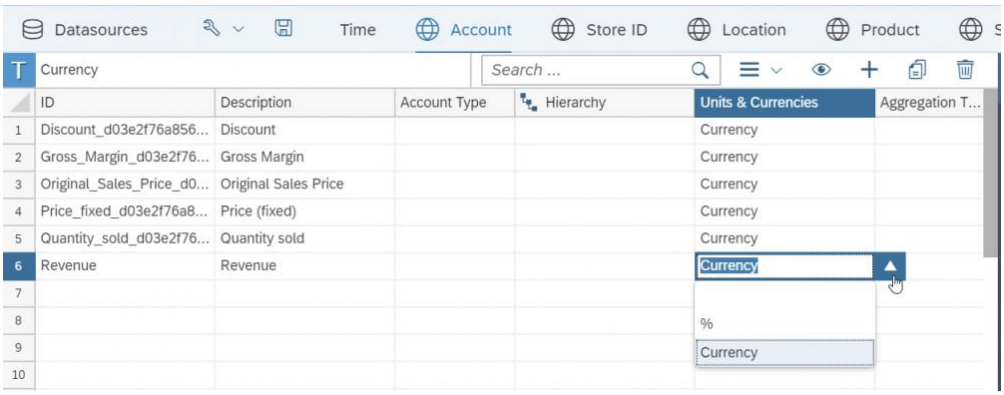


Figure 30: SAC Set units and currencies

4.3.2.5. Creating hierarchies

Hierarchy is used to establish parent-child relationships within data. For example, suppose we have sales data for the following:

- Global
- Continent
- Country
- State / Province
- City

Users can create a hierarchical relationship by establishing Global sales as the parent, Continent as the child, and then continue to do this all the way down. It would look something like this:

- Global
  - Continent
    - Country
      - State / Province
        - City

Once in Story mode, users enriched charts will allow them to drill down the different layers.

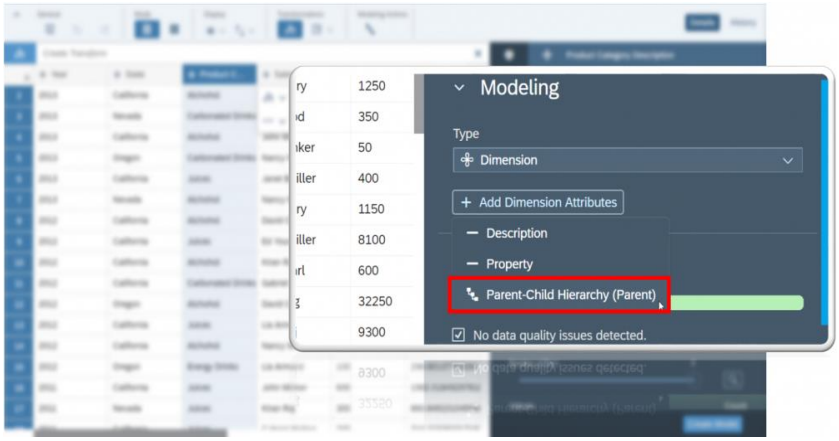


Figure 31: SAC Create Hierarchy

4.3.2.6. Adding formulas

Formulas allow users to create new measures, which are convenient and save them time in stories. For example, following the past examples, there are two measures (original sales price and discount). We can create a formula to give us a new measure called 'Revenue'

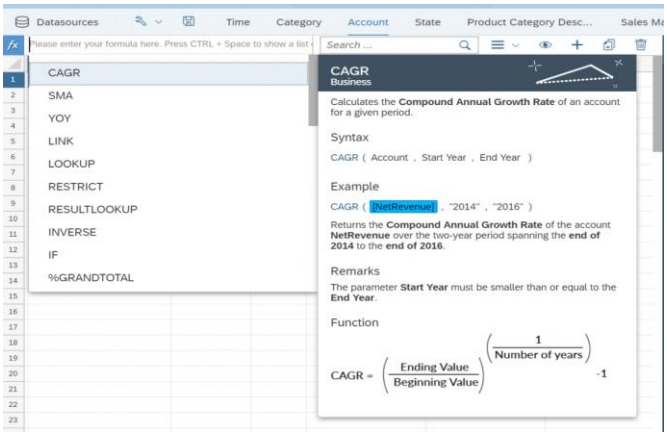


Figure 32: SAC Add Formulas

4.3.2.7. Geo enriching data

Geo maps are actually created in Modeler using location data. This acts as the foundation for the map in the story. There are two ways to geo enrich data: by Coordinates, and by Area Name.

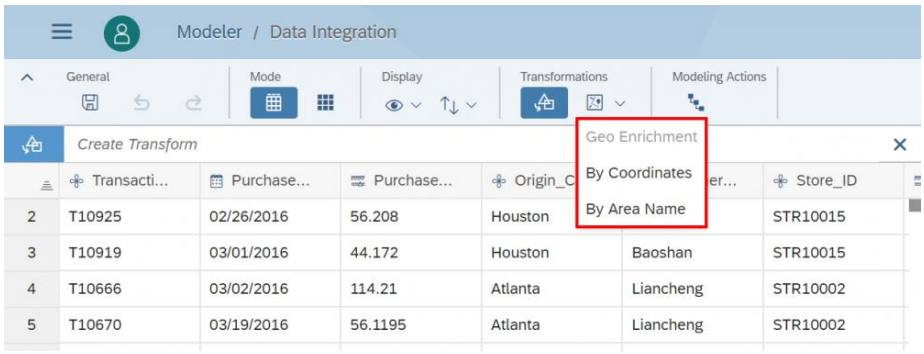


Figure 33: SAC Geo Enrich Data

Geo enriching data by **coordinates** enables users to use longitude and latitude coordinates. Our data may already include this information, but we could also enter it manually. These coordinates are used to create a map anywhere in the world. We can also have different levels of granularity so users can drill down from country, region, sub-region 1, sub-region 2.

Geo enriching data by **area name** enables users to create geo maps without the need for exact longitude and latitude coordinates, but it's limited to the United States. This option is great if user's company does business in America and the transactional data doesn't include latitude and longitude coordinates. One other thing to be aware of is that geo enriching by area name doesn't allow for drilling down past the city level. Enrichment is for state and country.

Now that we've seen the two ways to geo enrich the data, let's show how do we create it. In this example, we have two locations IDs: Store ID and Receiver ID, and both have latitude and longitude coordinates.

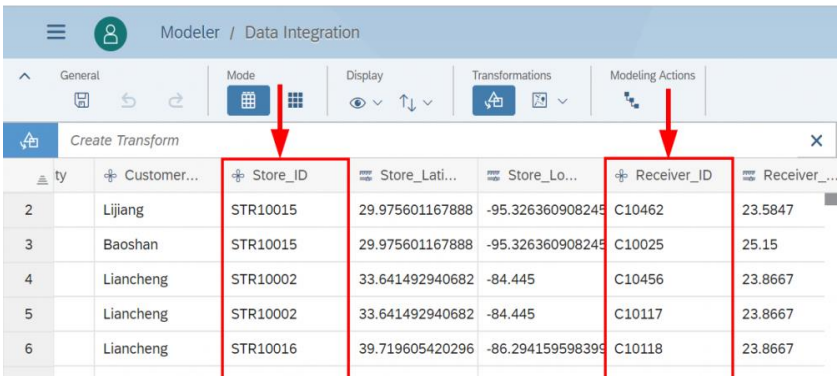


Figure 34: SAC Two Locations IDs

This is good because we can create a flow map, charting the course of our shipments. If we only had one location ID, we couldn't show this flow. When we select the geo enrichment option, 'Geo by Coordinates', a new dialog window opens, allowing users to create their new location dimension. There are three fields we need to complete:

- **Dimension name:** we can create a dimension name which will help us identify it in our story.

- **Identifiers:** we can select the Location ID for out store locations.

- **Coordinates:** we need to map our latitude and longitude to the correct location dimension.

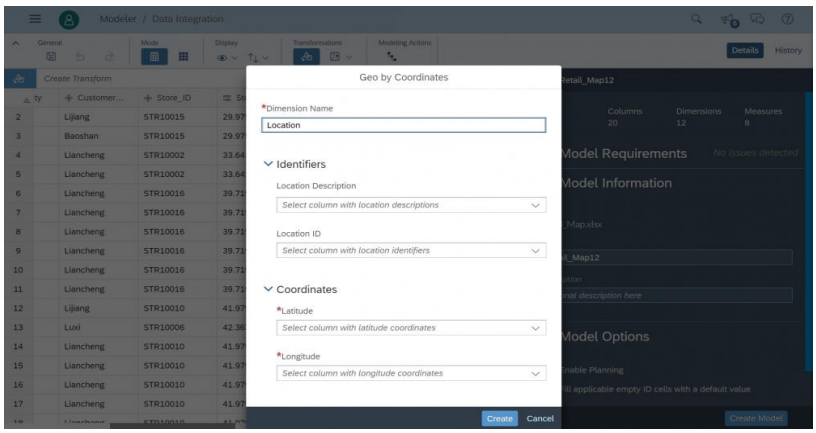


Figure 35: SAC Create Geo Enrich by Coordinates

Once we select 'Create' in both dimensions, we can use a flow map to chart the routes.

4.3.3. Creating a story

As we have seen in the previous section, models are the foundation of stories. We have the following five different options to start a history. Let's analyze it one by one.

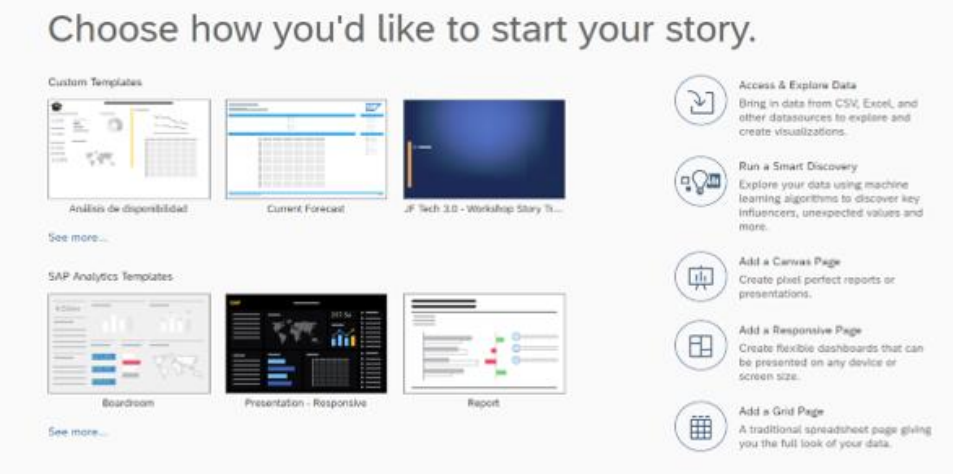


Figure 36: SAC Create Story Screen

4.3.3.1. Templates

Before start talking about the different ways for creating a history, in the screen above we can see that the system provides custom templates that help users to avoid the dreaded blank canvas of despair. Templates represent a quick and easy way to get user's story up and running. The story creator offers a variety of custom templates that users can choose to give its story some structure. Once users choose a template, they're brought into Pages View where they can customize its story.

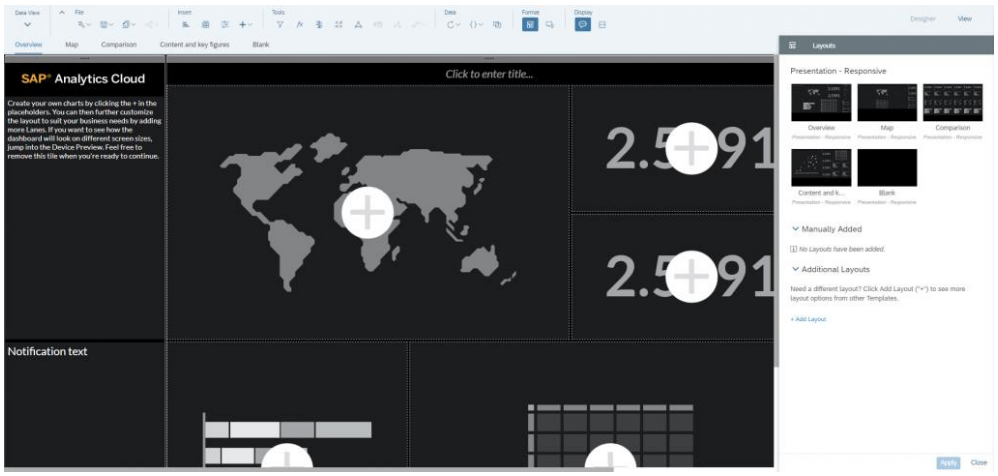


Figure 37: SAC Custom Template

Users can also create its own template, which can save them a lot of time. Once they have created its story the way they like, they can save it by navigating to the Save icon and select Save As Template from the list. Saving story as a template remove all data and converts charts, tables, maps, and input controls into empty placeholders. All grid pages will be blanc and win not retain any of the applied styling. When any user will create a new story, the template will be among the ones available.

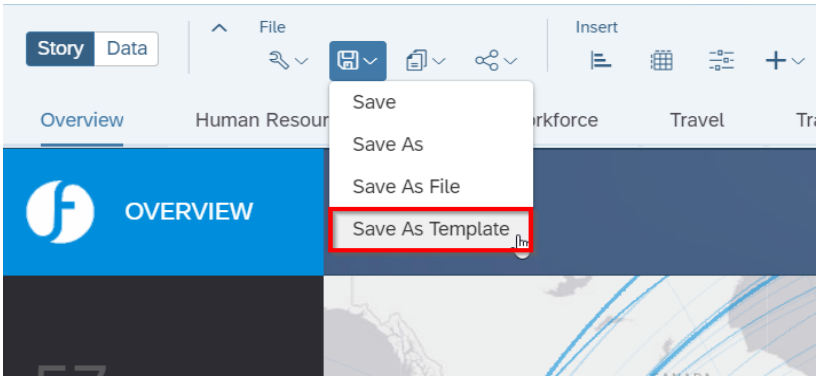


Figure 38: SAC Save As Template Option

4.3.3.2. Access & Explore Data

Once we select the first option, we can add data to the story from an existing model, a file, or a data source. To explain the different cases, we work with the option to create a story from an existing model.

Data View give us a buffet of choices so that we can decide how to begin telling our story. As we select different measures and dimensions, charts are automatically created, which we can copy to our story.

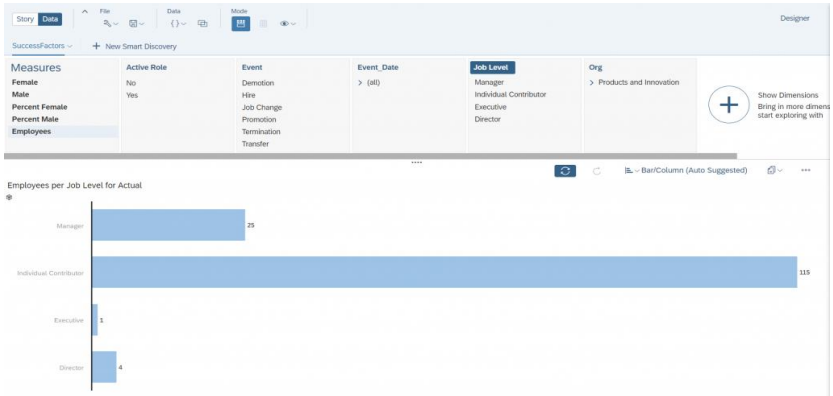


Figure 39: SAC Access & Explore Data

Once we're ready with our charts, we can go into Story View and see our story take shape. We can refine our story by modifying and arranging the charts, colors, and add visual elements. Users can always return to Data View by selecting the toggle icon in the toolbar.

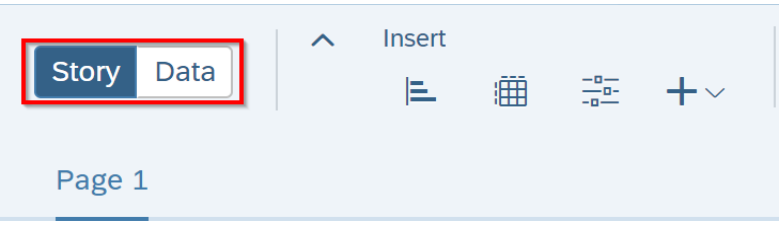


Figure 40: SAC Story and Data Options

4.3.3.3. Creating a chart

SAP Analytics Cloud offers a variety of charts that users can use to convey its message. Adding a basic chart is intuitive, just choosing the type of chart we want and then choose measures and dimensions. In the following example, we see how we can take an average looking chart, and transform it.

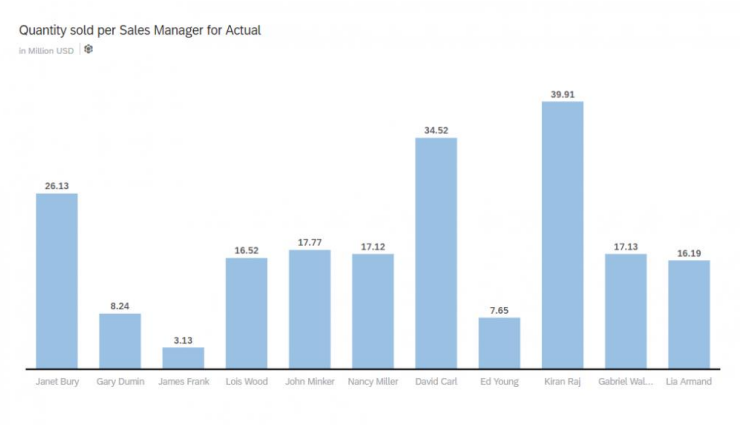


Figure 41: SAC Bar Chart Example

While this chart technically has all the information we need, we can enhance it to make the information pop. We may want to change the colors, the sorting order, the font size, the title, etc.

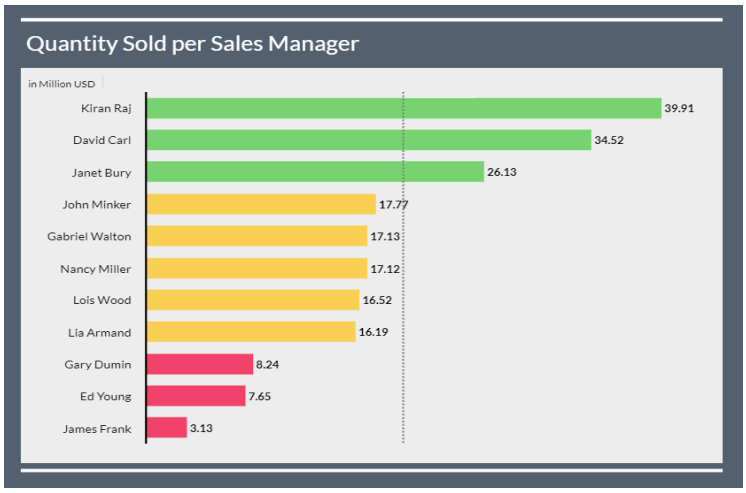


Figure 42: SAC Bar Chart Improved

Here is that same chart with some modifications. Now we can clearly see which sales managers are on target and which are not. We can also click on any of the data points and launch the **Smart Insights** discovery panel to uncover the key drivers behind easy of the managers' sales. The Smart Insight tool help users to answer the questions about the principal contributors on the selected value.

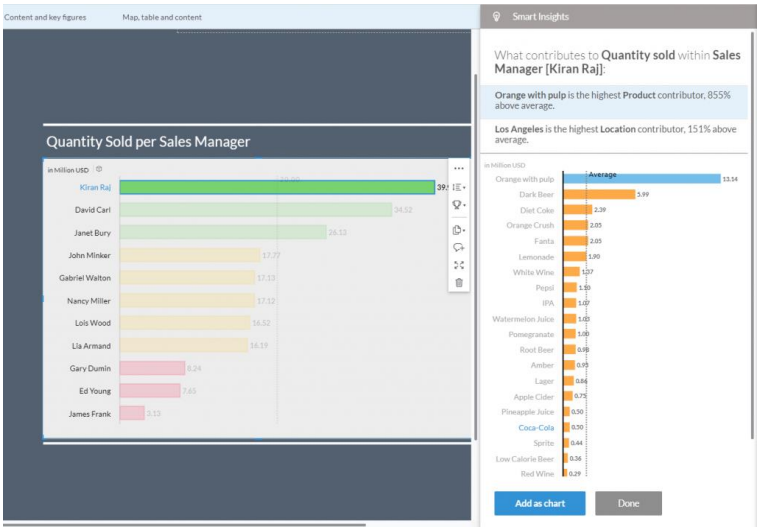


Figure 43: SAC Smart Insights Example

4.3.3.4. Creating a table

Tables are a great way to organize a lot of numeric values. They are also something that many people are familiar with.

Figure 44: SAC Create a Table

The table in this example explores the data for various sales managers. In this table it's added a threshold to the 'Quantity Sold' column to highlight which of the sales managers are meeting their targets. We can also take tables to a new level with in-cell charts. In addition to numeric values, we can also display charts that are embedded within the cells.

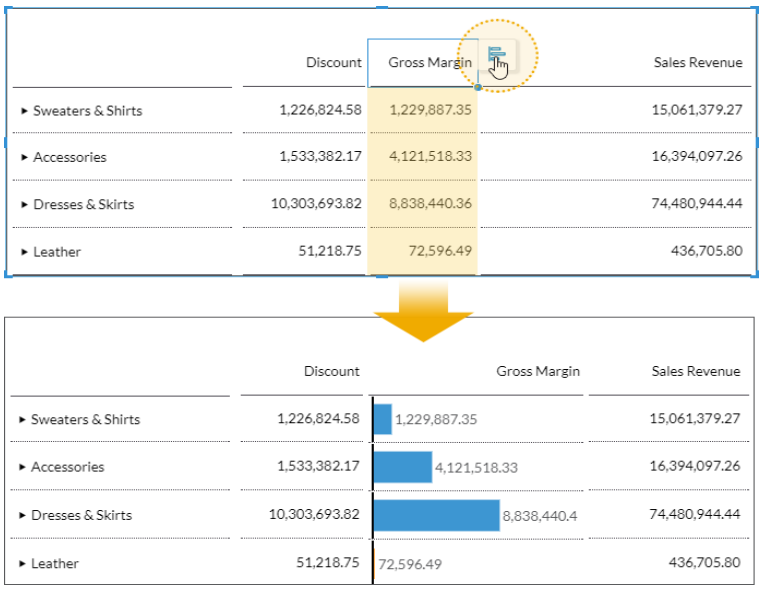


Figure 45: SAC Change Design on a Table

4.3.3.5. Run a smart discovery

Smart Discovery is a powerful feature within SAP Analytics Cloud that uses machine learning to explore data and uncover valuable insights. The feature enables users to:

- Discover the key influencers driving KPIs
- Gain insights about these influencers
- Identify outliers
- Analyze patterns in data
- Use historical data to predict future outcomes
- Simulate 'what-if' scenarios

After selecting the model, we can select a single measure or dimension and start finding insights. Then, we can exclude all the measures and dimensions that we don't want included in the analysis, and we also can filter the data. Now we can run the Smart discovery and begin analysis.

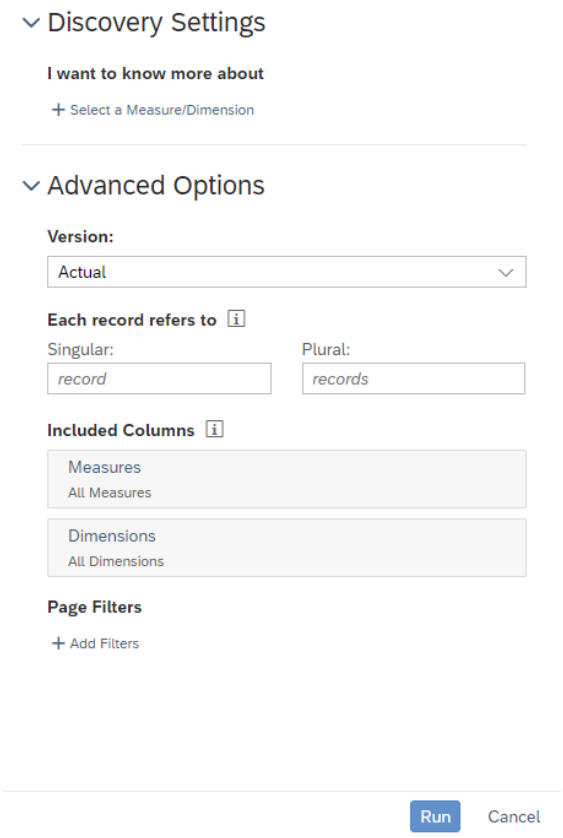


Figure 46: SAC Smart Discovery Settings

After running Smart Discovery, four main pages will appear:

- **Overview:** displays a general view of the measure or dimension selected, the evolution through time and the comparison with other variables.

- **Key Influencers:** displays the key influencer variables to the objective dimension or measure. In addition, the application displays charts to see how do the most 3 influenceable variables modify the objective variable.

- **Unexpected values:** displays the unexpected values in the dataset to understand the differences between predicted and current values.

- **Simulation:** allows the user to test hypothetical scenarios. The chart on the middle of the screen displays all the measures and dimensions we selected in the beginning, and excludes all the ones we didn't select.

4.3.3.6. Responsive pages for mobile

Creating story responsive pages allows users and its team to view stories on mobile devices. Responsive pages are made up of lanes where users can place its charts, graphs, tables, and other visual elements. When a responsive page is viewed on different sized devices such as smartphones or tablets, the tiles automatically re-flow to fit the lanes. If users want to see how their dashboard will appear on different screen sizes, then can view it in the Device Preview.

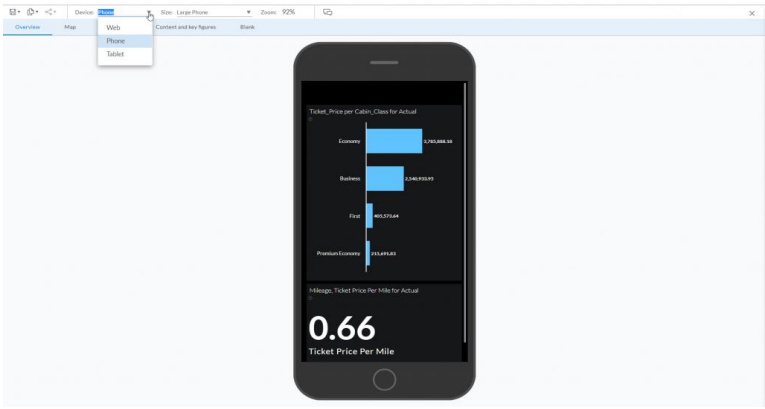


Figure 47: SAC Mobile

4.3.3.7. Sharing and collaboration

Stories are meant to be shared, and collaboration often lends itself to better results. In SAP Analytics Cloud users can do both. Collaborating stories is made easy with the built-in collaboration tools. Users can collaborate on a story by creating a discussion with colleagues, posting comments, or adding tasks for others to complete.

When sharing internally, the user will receive a notification that we have shared a story with them along with a hyperlink to the story. If we left any comments or tasks, the other users will be able to see them, respond, and add comments of their own.

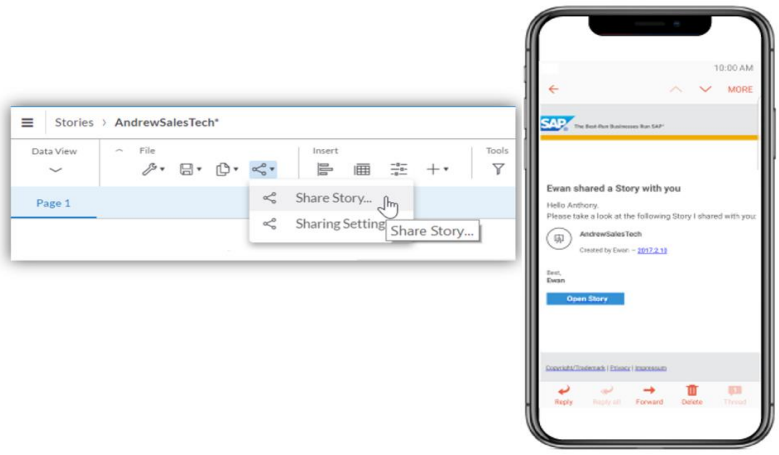


Figure 48: SAC Share Stories

4.3.4. Plans and Pricing

In the following table we can see all the subscription plans and choose the one that's the best fit for users and their business.

Plan	Price	Description	Includes
30-Day Trial	Free	See what SAP Analytics Cloud for business intelligence can do with a 30-day free trial	- SAP Analytics Cloud for business intelligence (limited capabilities)
Business Intelligence	$23 per user/month	Answer questions with self-service business intelligence based on trusted information	- SAP Analytics Cloud for business intelligence - SAP Analytics Cloud for planning (view-only)
Planning	$148 per user/month	Run your business with one simple cloud solution for both planning and analysis	- SAP Analytics Cloud for business intelligence - SAP Analytics Cloud for planning (standard or professional)
Custom	Request	Start a decision-making revolution with analytics solutions for every aspect of your business	- SAP Analytics Cloud for business intelligence - SAP Analytics Cloud for planning standard - SAP Analytics Cloud for planning professional -SAP Digital Boardroom - SAP Analytics Hub

Table 2: SAC Plans and Pricing

5 Project Design

In this section we see all the information we have needed to build our application. First, it is introduced all kind of data we needed to import to the SAP Analytics Cloud, and then it's seen which requirements and main answers that this data can answer us through the dashboard.

5.1. Necessary Data and Origin of the Data

In order to get our data and start developing the application, we had to connect to different data sources. Following, are specified the data sources we've used for the application and what type of data we've taken from it:

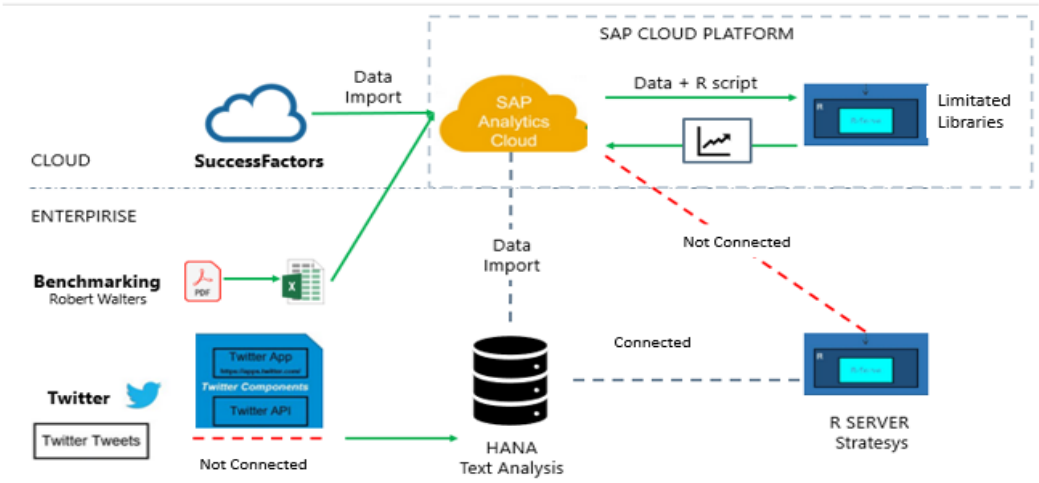


Figure 49: People Analytics Sources

5.1.1. SAP SuccessFactors

SuccessFactors is a worldwide leader in solutions of Business Execution Software based in cloud. The key of its success lies in the combination of developing of the employees with business objectives. In this way, the company's strategy is included in daily operations at all levels of hierarchy ensuring its competitive advantage. There are a total of 15 independent and fully integrated modules of BizX Suite.

SAP SuccessFactors

Figure 50: SAP SuccessFactors Logo

The connection for obtaining data from SuccessFactors is based on the type of connection *Open Data Protocol* (OData), a standard protocol for the creation and use of Application Programming Interfaces (APIs). Access to SuccessFactors is done through the HCM Suite OData API. This API provides a method of accessing CRUD data (creation, reading, updating and deletion) and allows optimizing processes that require frequent and real time queries.

The data from the different ODatas provides us different information about Human Resources and each information is related with each other. The Turnover group is powered by the Same OData as the Headcount group (EmpJob), and it's because both want to analyze different situations despite the same data. In our case, the Turnover one, is intended to investigate the number of employees leaving the company and the reasons for them, according to age, professional category, etc...

In the following table we can see the relationship between the SAP Analytics Cloud field, the type of the field (dimension or measure) and the sourcing SuccessFactors field.

SAC field	Type	SSFF field
Year	Dimension	YEAR(empJob.startdate)
Month	Dimension	MONTH(empJob.startdate)
Area	Dimension	empJob.businessUnit
Professional category	Dimension	empJob.jobCode
Género	Dimension	empJob.gender
Headcount	Measure	COUNT(empid)
Terminations headcount	Measure	empJob.contractEndDate
High performance terminations headcount	Measure	-
Age group	Dimension	empJob.dateOfBirthId
Employee	Dimension	empJob.userId/firstNameId/lastNameId
Employee performance	Measure	empJob.performance
Employee performance AVG	Measure	empJob.performance
Employee satisfaction level	Measure	-
Performance level	Dimension	empjob.performance
Reason for turnover	Dimension	empJob_userNav.reasonForLeaving
Voluntary turnover	Measure	Count(empJob_userNav.reasonForLeaving)
Voluntary turnover %	Measure	-
Turnover risk	Measure	empJob_userNav.riskOfLoss
Salary level	Dimension	empJob_userNav.salary
Employee number of projects	Measure	-

Table 3: SAC and SuccessFactors Fields

In order to connect two different models or combine different Data Sources in the same model, we can follow 2 procedures:

- **Combine Data:** this SAP Analytics Cloud function allows to take data from different queries at the same time. The problem that presents it's that only allows joining them by a field (normally, the UserId), which causes other key records become duplicated.

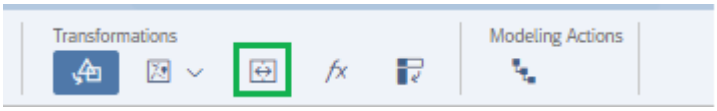


Figure 51: SAC Combine Data

- **Union through data imported directly in the model:** the second option consists in importing data directly from the model through Draft Sources, following this process:

    1) We create in the model the fields, dimensions or measures, that are going to be imported.

    2) We import through the SuccessFactors connection, the fields we need from a certain source. It's important to take the new fields we want to include in the model and also try to take all the possible fields that match those already in our model.

    3) We map the fields, ensuring that the automatic mapping performs the mappings correctly.

    Following this way, we can ensure that only become duplicated the records for which we have incorporated the data

The ODatas have certain common fields that allow to relate the data of the different tables to each other, as we can see in this table.

OData	Fields			
	UserId	**StartDate**	**FormDataId**	**FormContent ID**
Empjob	X	X		
Empjob_UserNav	X	X		
Empjob_PositionNav	X	X		
Empjob_employmentNav	X	X		
Empjob_companyNav	X	X		
Empjob_contractTypeNav	X	X		
EmployeeTime	X	X		
CompetencyRating	X		X	X
TalentRatings	X		X	X
FormHeader			X	
JobApplication				
EmpPayCompRecurring	X	X		

Table 4: OData Fields

It can be seen that the UserId field is the one that joins mainly all the data sources, together with the StartDate field. The UserId is unique for each employee, so it allows identifying the data of the other tables that refer to a particular employee.

In addition, to establish a solid data model, the different ODatas must have a temporary connection that relates to each other. This connection is made through a StartDate field, in the format "DD/MM/YYYY", common to all ODatas and that will allow its union at a temporal level, as well as the fields that are time dependent.

5.1.2. Benchmarking

Benchmarking is a process that seeks the improvement of the company, taking as reference values of the most outstanding companies in the sector. To know the data of these companies are used consultancies or companies dedicated to human resources. There are numerous companies that provide data of this type. In this project, the data has been provided by the following companies.

- **Robert Walters:** is one of the leader's consultancies in searching and selection. Organizations turn them to find highly qualified middle managers for a wide variety of areas of expertise. Professionals looking for a new job, whether permanent or temporary, turn to them to find the job they want.

Figure 52: Robert Walters Logo

- **Michael Page:** is one of the world's most reputable recruitment consultancies, working with different organizations from SMEs to major blue-chip companies. The number of clients and candidates who return to use their services time and time again is a testimony to their reputation and expertise.

Figure 53: Michael Page Logo

- **Hays:** is one of the leading global specialist recruitment group and the market leader in places such as the UK, Germany, and Australia. They are experts in recruiting qualified, professional and skilled people across a wide range of specialized industries and professionals. The company operates across the private and public sectors, dealing in permanent positions, contract roles and temporary assignments.

Figure 54: Hays Logo

- **Randstad:** is a global leader in the Human Resources services industry, by combining passion for people with the power of today's intelligent machines, they support people and organizations to realize their true potential.

Figure 55: Randstad logo

This data is provided by a flat file, in .csv format, which is loaded directly into SAP Analytics Cloud. To optimize this process, a File Server could be implemented, which allows access from SAC to all the files included in int. In our case, two types of files are loaded, differentiated by their structured:

- **File 1:** Year, Rotation, High Quality Rotation
- **File 2:** Professional Category, Average Salary

5.1.3. Social Media

In the Turnover tab, one of the sections focuses on social media and the daily interaction of the people with them. This process is based on the extraction of data directly from the social networks and allows to obtain opinions on companies or products based on keywords. Through Sentiment Analysis (or feeling analysis), we can obtain a statistic of, for example, how many positive and negative comments are produced daily on a certain company. To do this, an extraction process is established, following the diagram below:

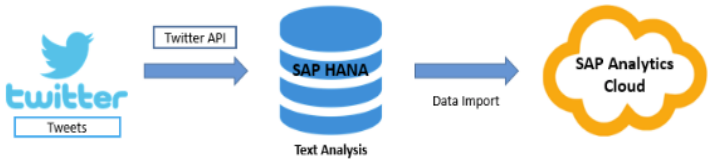


Figure 56: Text Analysis Integration Diagram

Following, all the steps that have been followed for the extraction of the tweets and upload it to the SAP Analytics Cloud.

1) **Obtain Twitter Tokens thought API:** to be able to extract data from Twitter, it is first necessary to create a developer account at Twitter official website. Just logged in and filled all the information, the next step is to keep all the security tokens for Consuming Twitter API's.

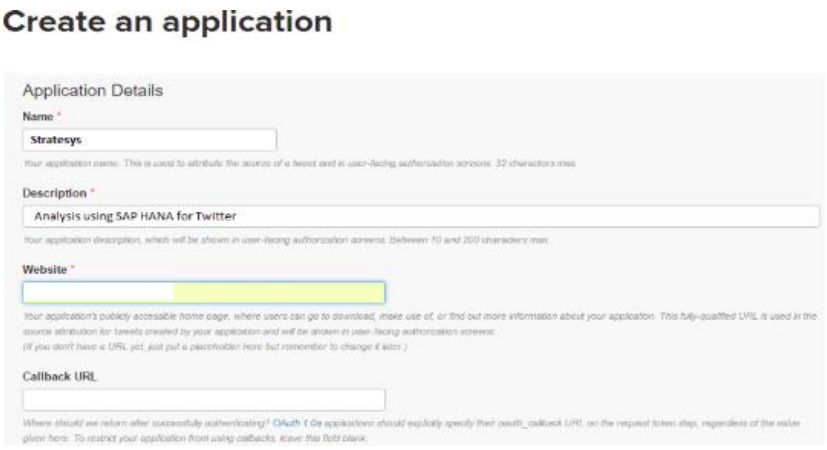


Figure 57: Twitter Application API

2) **Connection between the API and SAP Hana:** it is necessary to have downloaded the latest version of Twitter API for using it into the project and establish connection parameters. The project is uploaded into SAP, so it's only necessary to downloaded and overwrite it with our company information. Once the project is ready to be started, the first thing we do is to configure our information in the *Configurations* file.

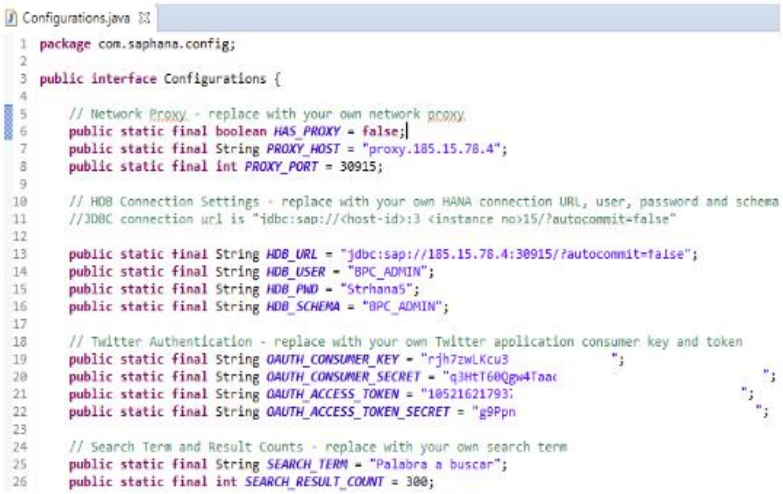


Figure 58: Configurations file

In line 25 we can see the String field required to be searched on the social network. After configuring the file, we are ready to connect Twitter and SAP HANA, and after the connection between them is established, it's time to invoke the twitter API for fetching the data from Twitter and insert the tweets into Hana System.

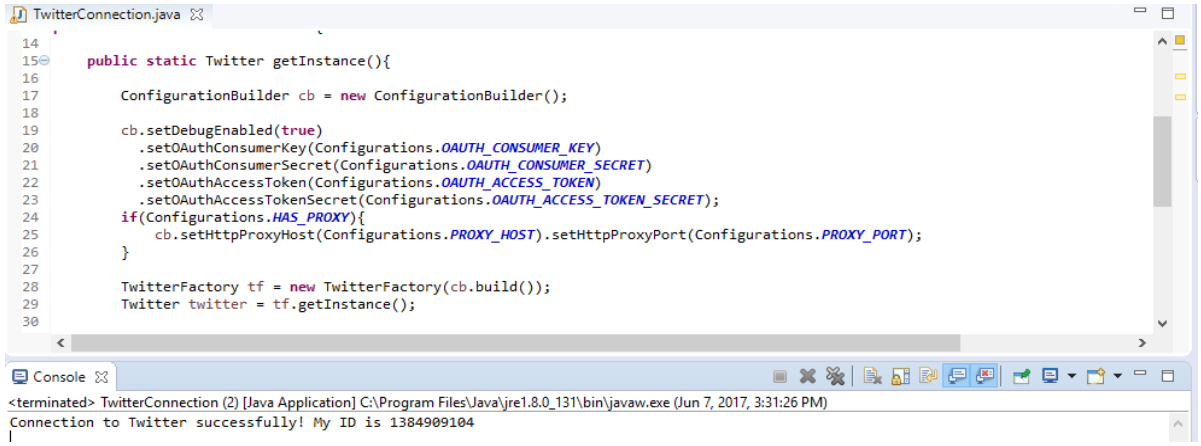


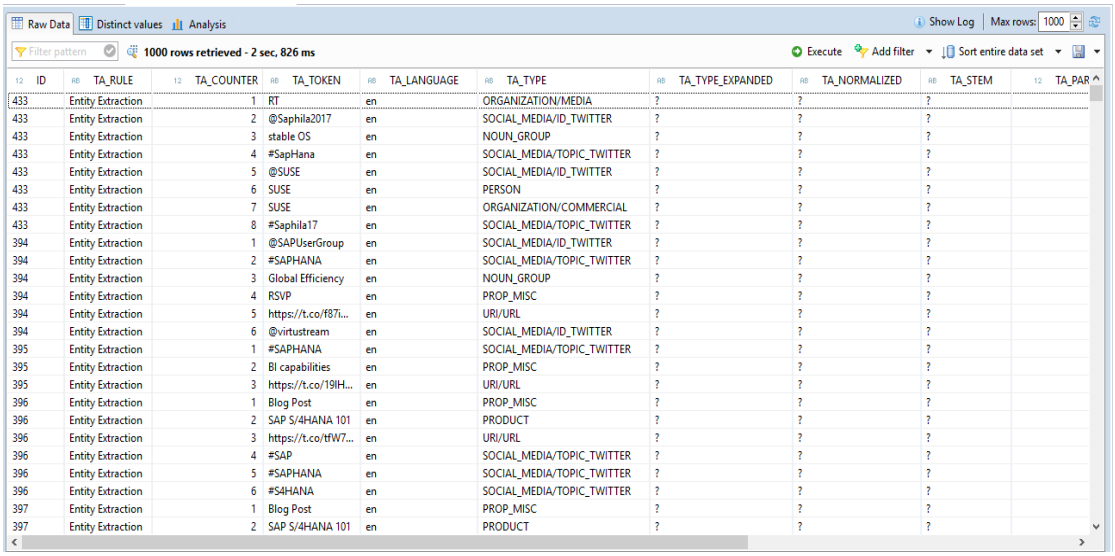
Figure 59: Twitter Connection File

Figure 60: Hana Data Base Connection File

3) **Prepare Text Analysis:** once we've the tweets in our Hana System, it is time to leverage the text analysis capabilities of SAP Hana create FullText Index on Tweets table. Data is going to be classificated in function of the different types of sentiment words. To get this information, it has to be used this SQL sentence:

```
CREATE FULLTEXT INDEX myindex ON "BPC_ADMIN"."TWEETS" (TEXT)
        CONFIGURATION 'EXTRACTION_CORE_VOICEOFCUSTOMER'
        LANGUAGE DETECTION('ES')
        TEXT ANALYSIS ON;
```

Figure 61: Text Analysis SQL Sentence



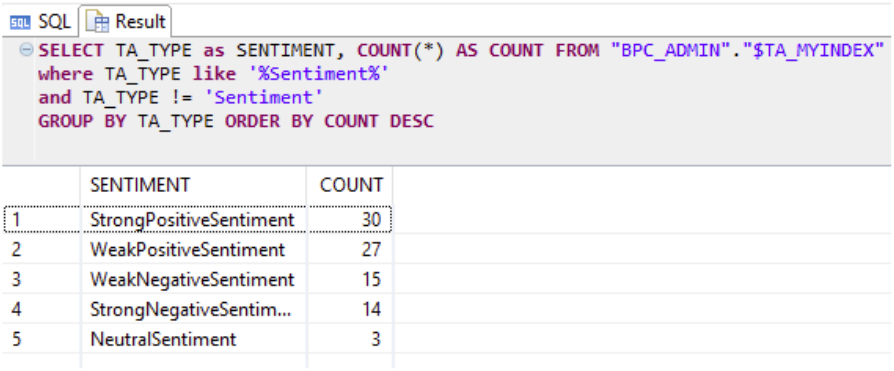
Raw Data | Distinct values | Analysis — Show Log — Max rows: 1000

1000 rows retrieved - 2 sec, 826 ms — Execute — Add filter — Sort entire data set

ID	TA_RULE	TA_COUNTER	TA_TOKEN	TA_LANGUAGE	TA_TYPE	TA_TYPE_EXPANDED	TA_NORMALIZED	TA_STEM	TA_PAR
433	Entity Extraction	1	RT	en	ORGANIZATION/MEDIA	?	?	?	
433	Entity Extraction	2	@Saphila2017	en	SOCIAL_MEDIA/ID_TWITTER	?	?	?	
433	Entity Extraction	3	stable OS	en	NOUN_GROUP	?	?	?	
433	Entity Extraction	4	#SapHana	en	SOCIAL_MEDIA/TOPIC_TWITTER	?	?	?	
433	Entity Extraction	5	@SUSE	en	SOCIAL_MEDIA/ID_TWITTER	?	?	?	
433	Entity Extraction	6	SUSE	en	PERSON	?	?	?	
433	Entity Extraction	7	SUSE	en	ORGANIZATION/COMMERCIAL	?	?	?	
433	Entity Extraction	8	#Saphila17	en	SOCIAL_MEDIA/TOPIC_TWITTER	?	?	?	
394	Entity Extraction	1	@SAPUserGroup	en	SOCIAL_MEDIA/ID_TWITTER	?	?	?	
394	Entity Extraction	2	#SAPHANA	en	SOCIAL_MEDIA/TOPIC_TWITTER	?	?	?	
394	Entity Extraction	3	Global Efficiency	en	NOUN_GROUP	?	?	?	
394	Entity Extraction	4	RSVP	en	PROP_MISC	?	?	?	
394	Entity Extraction	5	https://t.co/f87i...	en	URI/URL	?	?	?	
394	Entity Extraction	6	@virtustream	en	SOCIAL_MEDIA/ID_TWITTER	?	?	?	
395	Entity Extraction	1	#SAPHANA	en	SOCIAL_MEDIA/TOPIC_TWITTER	?	?	?	
395	Entity Extraction	2	BI capabilities	en	PROP_MISC	?	?	?	
395	Entity Extraction	3	https://t.co/19IH...	en	URI/URL	?	?	?	
396	Entity Extraction	1	Blog Post	en	PROP_MISC	?	?	?	
396	Entity Extraction	2	SAP S/4HANA 101	en	PRODUCT	?	?	?	
396	Entity Extraction	3	https://t.co/tfW7...	en	URI/URL	?	?	?	
396	Entity Extraction	4	#SAP	en	SOCIAL_MEDIA/TOPIC_TWITTER	?	?	?	
396	Entity Extraction	5	#SAPHANA	en	SOCIAL_MEDIA/TOPIC_TWITTER	?	?	?	
396	Entity Extraction	6	#S4HANA	en	SOCIAL_MEDIA/TOPIC_TWITTER	?	?	?	
397	Entity Extraction	1	Blog Post	en	PROP_MISC	?	?	?	
397	Entity Extraction	2	SAP S/4HANA 101	en	PRODUCT	?	?	?	

Figure 62: Text Analysis Result

4) **Text Analysis:** in order to give value to the data obtained, the Twitter-Analysis APP is used to allow us differentiating the extracted tweets based on the sentiment expressed (sorted by less or greater degree of satisfaction based on the words associated with the tweet), as shown in the following image:



SQL | Result

```
SELECT TA_TYPE as SENTIMENT, COUNT(*) AS COUNT FROM "BPC_ADMIN"."$TA_MYINDEX"
where TA_TYPE like '%Sentiment%'
and TA_TYPE != 'Sentiment'
GROUP BY TA_TYPE ORDER BY COUNT DESC
```

	SENTIMENT	COUNT
1	StrongPositiveSentiment	30
2	WeakPositiveSentiment	27
3	WeakNegativeSentiment	15
4	StrongNegativeSentim...	14
5	NeutralSentiment	3

Figure 63: Text Analysis Number of Words

5) **Upload data into SAP Analytics Cloud:** the last part of the process is to prepare the data and export it as a .csv file. After that, the tweet information is ready to be uploaded to the SAP Analytics Cloud and start building charts.

5.1.4. R Server

SAP Analytics Cloud is a tool that has numerous options and types of charts to visualize data. In addition, this tool has the option of visualization in R, which allows creating interactive visualizations to perform analysis and advanced statistics. SAP Analytics Cloud has its own R server, which allows the use of graphics to analyze and present the data. However, this server has limited libraries, so in our project we have chosen to include, a part from the SAC server, a connection to an external R server from Stratesys. In the following diagram, we can see the connection schema.

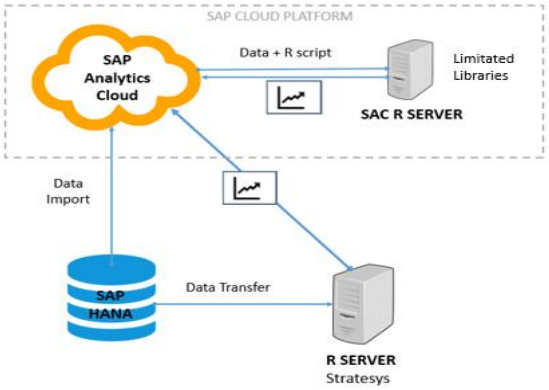


Figure 64: R Server Integration Diagram

5.2. Requirements

The People Analytics Dashboard it has been created in order to answer questions of the Human Resources Department of any company. As a general view, the tool helps in things such as:

- Optimization of the selection process.
- Analysis of the employees and diversity objectives.
- Costs control associated with the work team.
- Detection of shortage of critical skills of employees.
- Greater control of the risk of succession.
- Improvement of the absenteeism ratios and retention of talent through advanced analytics.

Despite all these requirements, in this section we refer to the requirements that refer the turnover and the high-performance employees' turnover in the company. The Turnover tab, will help any company to answer this kind of questions about the turnover of its business:

- Potentiate the high-performance employees from the company
- Understand the key indicators that affect more on the turnover rates in function of different motives.
- Analysis of social media to determine their effects on Human Resources management and turnover.
- Analysis of employee in function of their sentiment and their job in the company.
- Simulate the turnover rate and predict the employees that have more probability to leave the company.
- Understand employee needs and know what the company has to do to retain talent in the company.
- Help the company to know better their employees and know what they have to do to recruit new talent for the company.

All this requirement are based with intelligent analytical capabilities through predictive algorithms that allow evaluating the causes of deviations and simulate the most appropriate actions to correct them.

5.3. The People Analytics Dashboard

The People Analytics Dashboard is based in 7 tabs with different information, apart from the Overview one. In this section are listed the different tabs with a few description of their content:

- **Overview:** displays a general overview of the different content of the dashboard. Users can easily go to the page they want.

Figure 65: People Analytics Overview Tab

- **Headcount:** analysis of the global situation of company's team, locating each one of the workers by office and department. It is also included a study of the evaluation of the staff, the parity of them, and the average age of the employees.

Figure 66: People Analytics Headcount Tab

- **Absenteeism:** person-level analysis of the team employees that we don't have at this time or in the last month, whether dues to leave, vacations or other reasons.

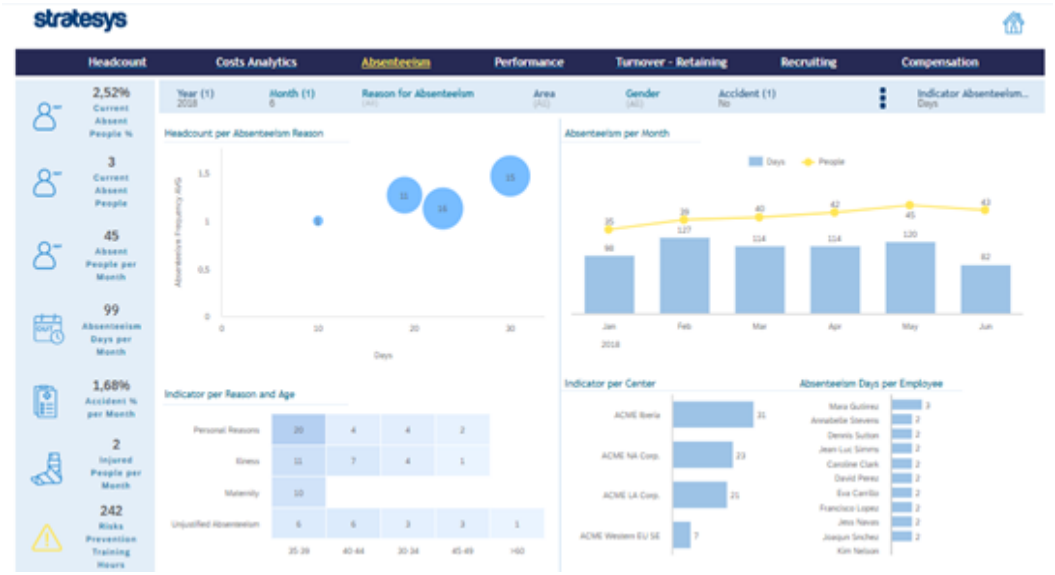


Figure 67: People Analytics Absenteeism Tab

- **Performance:** an analysis of the company's performance and strengths, both analyzed as a group and individual level. Also, there is a detail of training and evaluation of the employees.

Figure 68: People Analytics Performance Tab

- **Turnover:** detailed analysis of the rotation of the staff and the talent of the company. Includes predictive model and simulator to prevent the flight of the talent. This is the main tab of this project. In the following sections this tab will be developed in more depth and analyzed more in detail.

Figure 69: People Analytics Turnover Tab

- **Recruiting:** detailed analysis of the life cycle of the company's hiring processes, from when the offer is published until the new employees are hired.

Figure 70: People Analytics Recruiting Tab

- **Compensation:** detailed analysis of the gratification to employees for the work they do in the company. The information is compared with the average of the rest of the companies in the sector.

Figure 71: People Analytics Compensation Tab

5.4. Models and Datasets

As we talked in the SAP Analytics Cloud configuration, there are many ways to import the data to the cloud. In this section we talk about how we have imported the employee, benchmarking and social media information to the cloud and which models we have created to work with it. To develop the application, we've worked by the way of importing a csv file. First of all, here are the models we've created to save the information:

HRDatasetTalentRetainTest → Employee Information

Benchmarking → Market Information

StratesysTweets → Social Media information

Following there's a table for each model created and it will be shown the different fields of the file, the name they have in SAC and a column to differentiate if they are a dimension or a measure:

- HRDatasetTalentRetainTest

Field	SAC field	Dimension/Measure
Date	Date	Date Dimension
Year	Year	Dimension
Month	Month	Dimension
UserId	Employee	DImension
Name	Name	Dimension
Surname	Surname	DImension
Full Name	-	Dimension
Active	Active	Dimension
satisfaction_level	Satisfaction Level	Measure
last_evaluation	Performance	Measure
performance_level	Performance Level	Dimension
number_project	Number of Projects	Measure
average_monhtly_hours	Monthly hours	Measure
time_spend_company	time_spend_company	Measure

Work_acciddent	Work_accidentt	Measure
left	Turnover	Measure
promotion_last_5years	Promotion in the past 5 years	Measure
department	Area	Dimension
salary	Salary	Dimension
Gender	Gender	Dimension
Age	Age	Dimension
age_range	Age Group	Dimension
Professional_Category	Professional Category	Dimension
Reason_for_leaving	Reason for Turnover	Dimension
voluntar_turnover	Voluntary Turnover	Measure
leaving_probability	Turnover Risk	Measure

Table 5: HRDatasetTalentRetainTest Fields

- Benchmarking

Field	**SAC field**	**Dimension/Measure**
Year	Year	Dimension
Gender	Gender	Dimension
Source	Source	Dimension
Employee_tenure_years	Employee_tenure_years	Measure
Highperformer_turnover_rate_	High-performer turnover rate %	Measure
Involuntary_turnover_rate_	Involuntary turnover rate %	Measure
Overall_turnover_rate_	Overall turnover rate %	Measure
Promotion_rate_	Promotion rate %	Measure
Salary_increase_	Salary increase %	Measure
Voluntary_turnover_rate_	Voluntary turnover rate %	Measure

Table 6: Benchmarking Fields

- StratesysTweets

Field	SAC field	Dimension/Measure
CREATED_AT	CREATED_AT	Time Dimension
ID	ID	Dimension
USER_NAME	USER_NAME	Dimension
TA_TYPE	TA_TYPE	Dimension
TA_TOKEN	TA_TOKEN	Dimension
COUNT_TWEETS	Tokens_Sum	Measure
TA_COUNTER_SUM	TA_COUNTER_SUM	Measure

Table 7: StratesysTweets Fields

6 Dashboard Construction

The Turnover Dashboard is divided into 2 tabs: **Analytics** and **Simulation**. It is time to see the content of both tabs with an explanation for each chart.

6.1. Analytics

The Analytics tab is intended to show the current situation of the company employees, the comparison of the turnover of the company with the rest of the market competitors, the main reasons that cause the turnover of the employees, the analysis of the employee's sentiment through social networks and the analysis of satisfaction of the employees.

First of all, at the top of the page we find the story filters and different tabs that the People Analytics application has, and the option to switch to the Simulation tab.

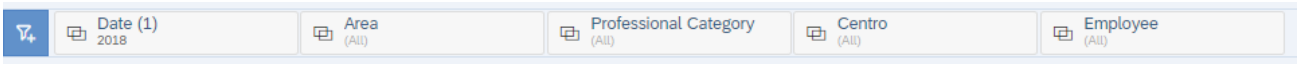


Figure 72: Story Filters

Figure 73: Story Header

6.1.1. Turnover

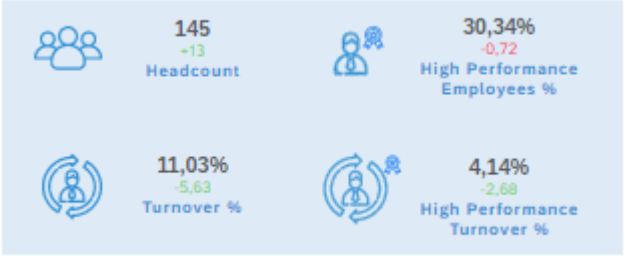


Figure 74: Turnover KPIs

The Analytics tab starts with a general information about the employees of the company. In numerical format (KPI) it can be seen the number of employees of the company, the turnover percentage, the percentage of talented and high-performance employees, and the turnover percentage of high-performance employees.

Just below each value it's shown the variation of the value with respect to the previous year, being in green color if we have more employees or less turnover percentage, or being in red color if the number of employees decreases or turnover percentages decreases too.

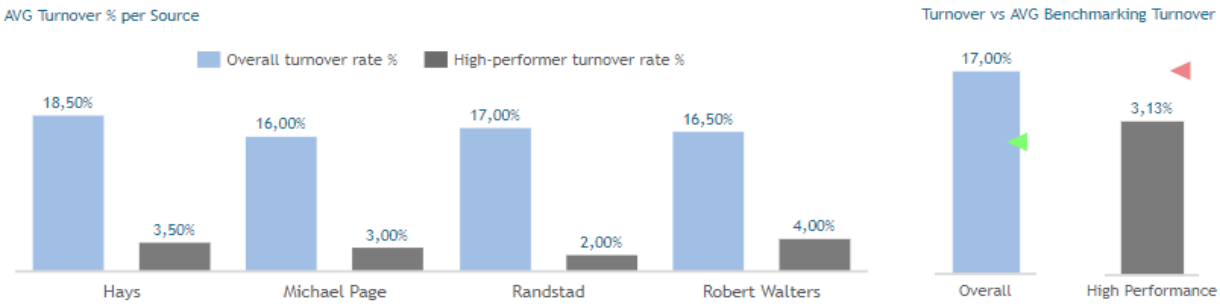


Figure 75: Average Turnover vs Benchmarking Turnover

On the right side of the general information, we find the comparison between the company turnover and the benchmarking data. The first chart displays the percentage of turnover at the general level and at the high-performance level for each of the benchmarking sources. The second graph displays the comparison between the turnover and the high-performance turnover with the rest of the market. The bar shows the average of the market and the triangle shows the average of the company. If the triangle color is green means that our average turnover is lower than the market, while if the bar is red, which means we're having more rotation than the rest of the market.

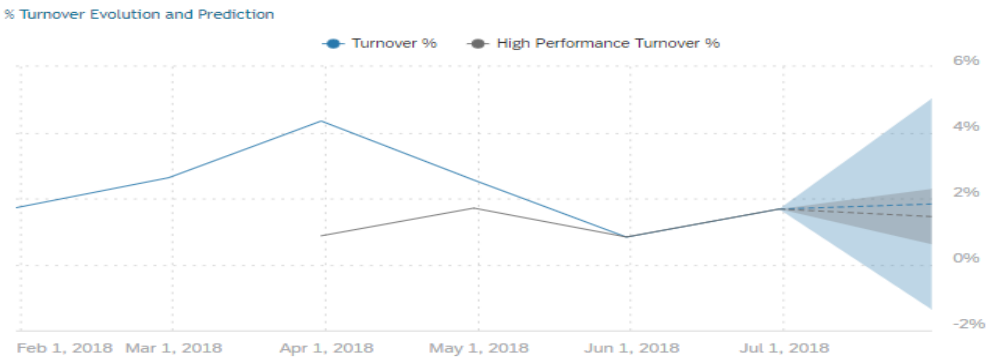


Figure 76: % Turnover Evolution and Prediction

Below the two previous charts, first there is a temporary evolution at the month level of the employee's turnover and the high-performance employees' turnover. In addition, as we explained during the document, we added a predictive function from the graph that predicts the value that both variables can reach in the coming months. The shaded area shows the maximum value and the minimum value and the dashed lines predict the future value more accurately.

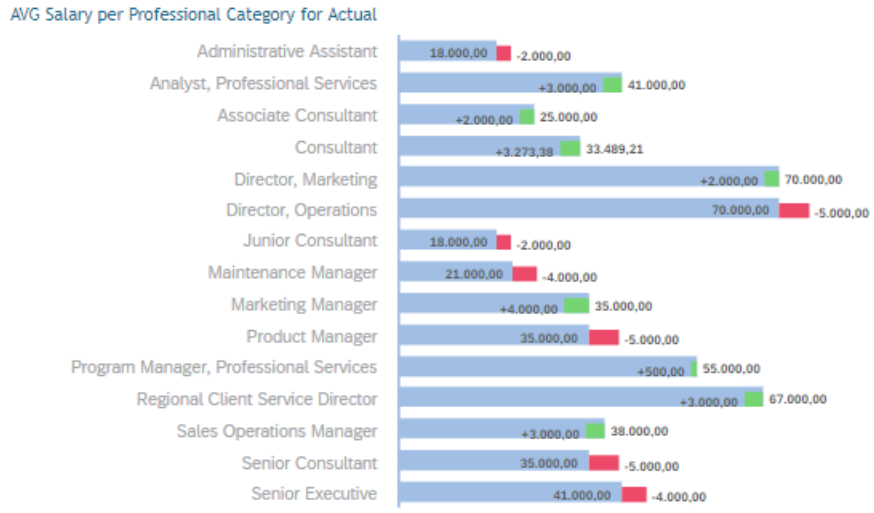


Figure 77: Average Salary per Professional Category

Second, we find a bar chart that displays the average salary of the company for each professional category. In addition, for each bar we find by an integrated bar the comparison of the salary of each category with the salary of market competitors. If the salary of the company is higher than the competitors, the bar it's shown in green, while if the salary is lower, it's shown in red.

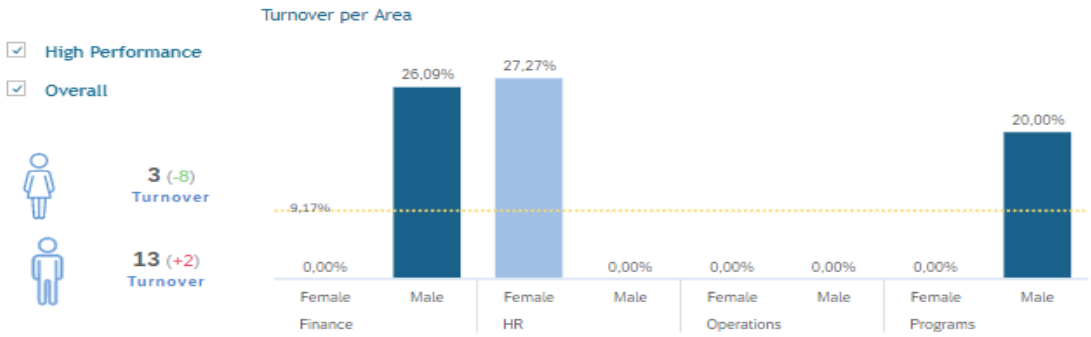


Figure 78: Turnover per Area and Gender

Continuing with the dashboard, we find this chart that displays the percentage of employee's turnover depending on the different areas of the company and gender. First, we find a selector where we can choose to type of employee's turnover we want to see (general, high performance or both). Just below de selector, we find by a KPI the number of men and women who have left the company and the variation respect the previous year. In the area of the chart, in addition, we find with a dashed line the average of employee's turnover.

Figure 79: Turnover Rates per Professional Category

Through a Tree Map it's shown the number of employees that have left the company according to each professional category. In addition, as we can see in the legend in the right, the color of each box shows the percentage of employee's turnover, going from less dark to darker as the percentage increases.

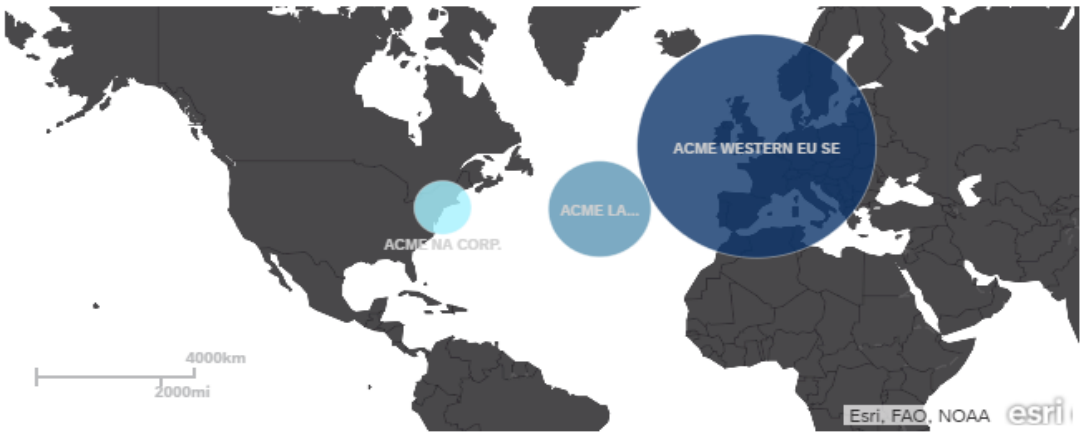


Figure 80: Turnover Locations

A chart that visually gives us a lot of information are the maps. We see for each place of the world a round where the company offers services. The size of the round indicates the number of employees who have left the company in that location, while the color indicates the employee's turnover percentage, being darker if the percentage increases.

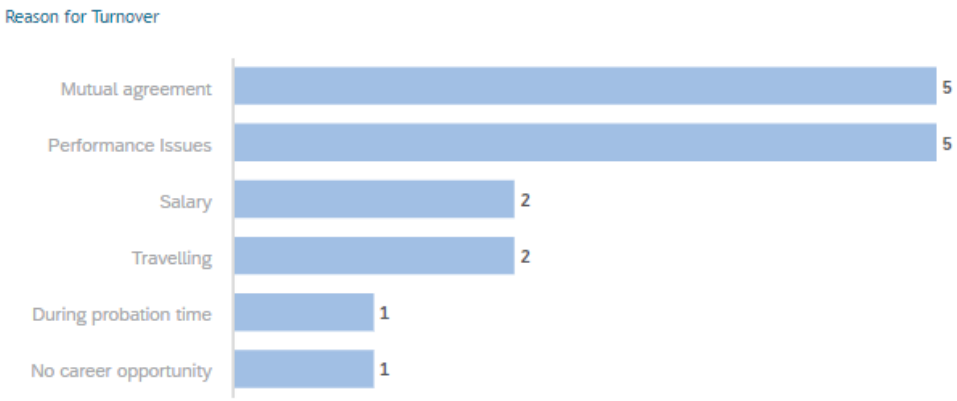


Figure 81: Reasons for Turnover

To finish the first part of the dashboard, we find this bar chart that shows the main reasons that have led employees to leave the company. The chart is sorted from most to least people, being Mutual Agreement and Performance Issues the main reasons.

6.1.2. Key Indicators

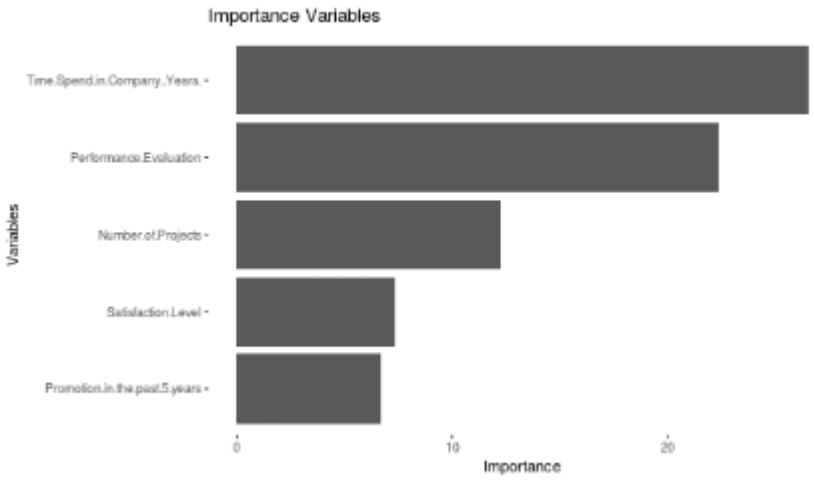


Figure 82: Key Indicators

The first chart of Key Indicators, through the analysis of the employees, shows the factors that employees consider more important to decide if they stay or they leave the company, being in this case the Time Spend in Company the factor that most influences. This chart has been implemented in R.

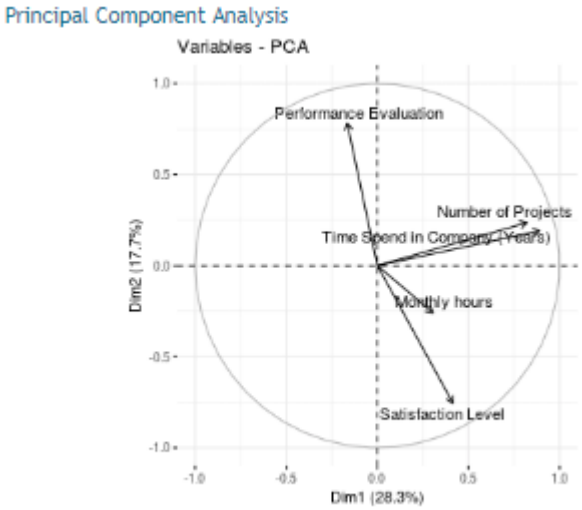


Figure 83: Principal Component Analysis (PCA)

This chart is named PCA (Principal Component Analysis) and shows the correlation that the variables have between them. The size of the arrows indicates if the variable affects more or affects less, being in this case the Performance Evaluation and the Satisfaction level the variables that affect more. The arrow of the Performance Evaluation is positive, that means that it influences positively to the increase of the turnover.

On the other side, the arrow of the Satisfaction level is on the negative axis, which means that it positively affects people to stay in the company. In addition, both arrows are inversely proportional, that means that to prevent that employees leave the company, they have to have a high level of satisfaction. This chart has been implemented in R.

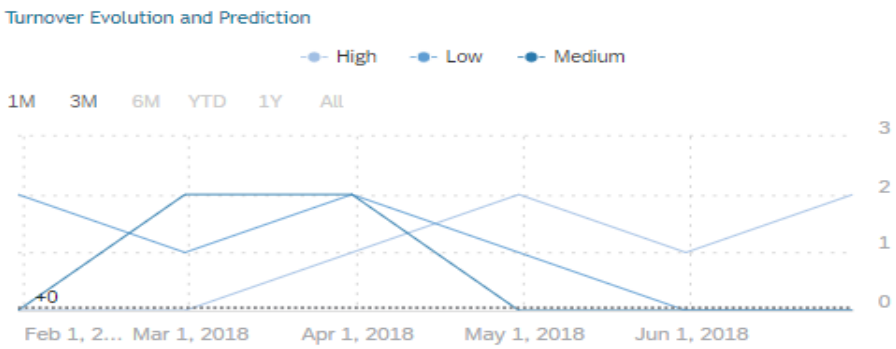


Figure 84: Turnover Evolution and Prediction

This chart displays the temporary evolution of the number of employees who have left the company based on their performance. We could choose the time period to see the data.

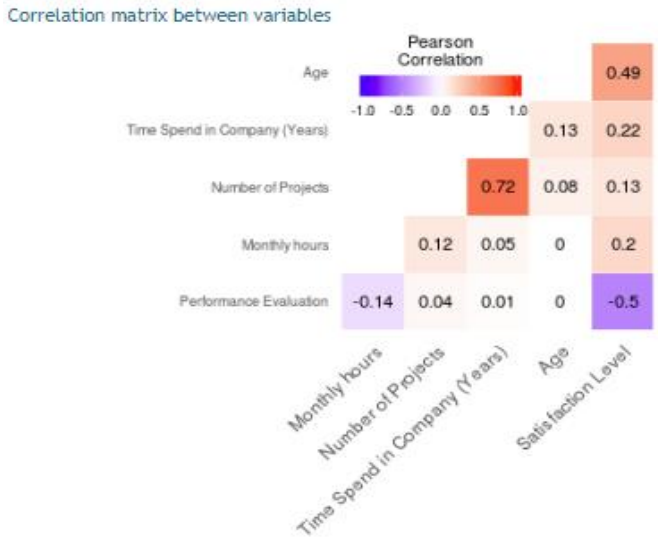


Figure 85: Correlation Matrix Between Variables

Following there's a correlation matrix between factors to see how which factors depends on the others. If the box is in purple means that there's no correlation between these two factors, whereas if the box turns red, it means that these variables correlate more. In this case we see that the factors that correlate most are the Number of Projects and the Time Spend in Company. This chart has been implemented in R.

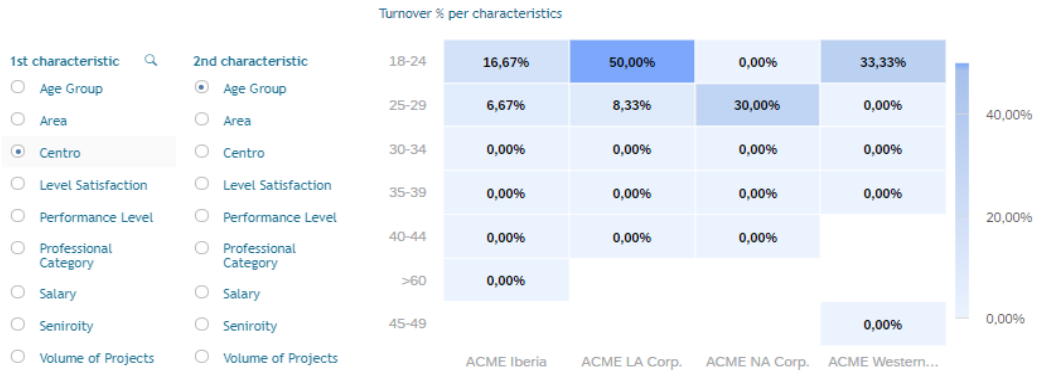


Figure 86: Turnover % per characteristics

The last chart of the Key Indicators part displays as a table the employees' turnover in function of two characteristics. In the two axes we see the characteristics, and in each box, we see the employee's turnover percentage and the color darkest if the percentage increases. In this case we can see the turnover percentages in function the Center and the Age Group.

6.1.3. Social Media and Sentiment Analysis

Figure 87: Tweets Sentiment Word Cloud

This section shows the information that we have extracted from real people tweets. In this first chart we can see a cloud of words with the words that have been more mentioned referring to the company, being the size of the word the number of times that the word has appeared in the mentions. The chart has been implemented in R.

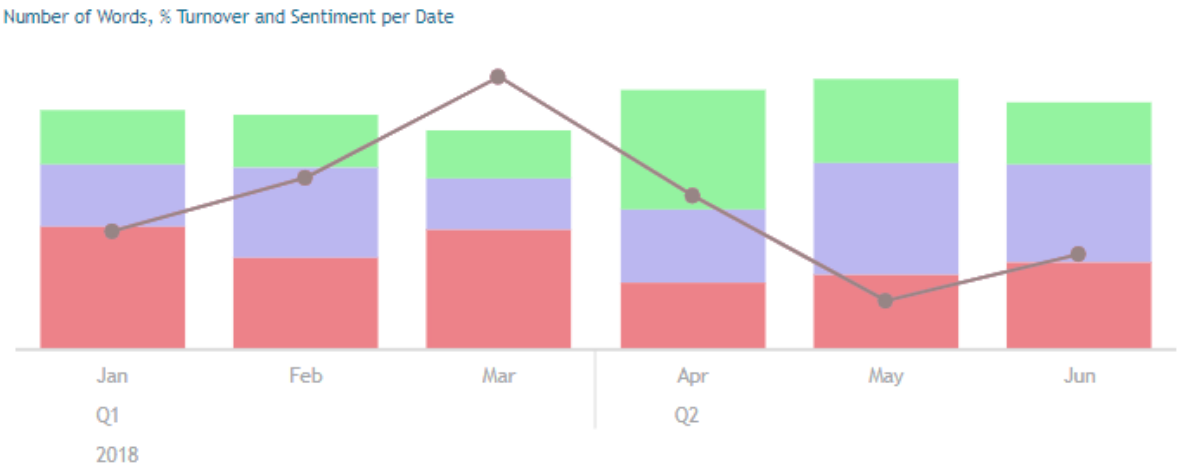


Figure 88: Evolution of Tweets and % Turnover

This second chart displays a temporary evolution of the number of words that have been written referring to the company. Thanks to the Sentiment Analysis tool, we can classify words according to whether they express a positive comment (green color), negative comment (purple color) or neutral comment (red color). In addition, the words are related to the evolution of employee's turnover to understand the change through people's opinions.

Figure 89: Total Employees by Satisfaction and Performance

This is the first chart of the last part of the Analytics tab. The cart displays a distribution of the employees based on their level of satisfaction in the company and their last evaluation. The color of the round shows the number of employees who are in the same situation, being yellow the color that represents the most employees. The chart has been implemented in R.

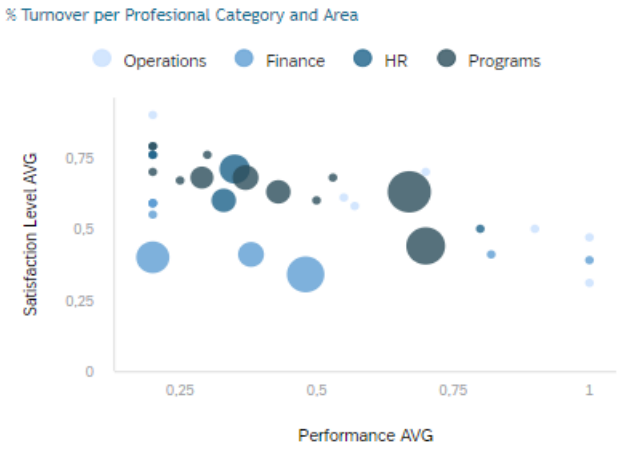


Figure 90: % Turnover per Professional Category and Area

This chart relates the employee's turnover percentage based on the average satisfaction level and average performance. The color of the circle shows the different departments of the company, and the size of the round increases as the percentage of turnover increases.

Figure 91: Satisfaction Level & Performance per Employee

This is the last chart that relates the level of satisfaction and the average performance. In this case, we can compare it at the employee level. If the color of the employee is in green means that the employee is still in the company, while if the color is in red means that the employee has left the company. We can see that as we have advanced, the information of the chart has been displayed from more general to more individual level.

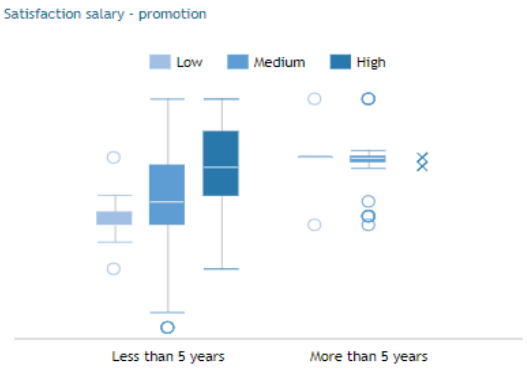


Figure 92: Satisfaction Salary and Promotion

This Box Plot chart displays the classification of employees according to the promotion level (less or greater than 5 years) and their salary. We see that most of the employees with less than 5 years since the last promotion have a medium or a high salary.

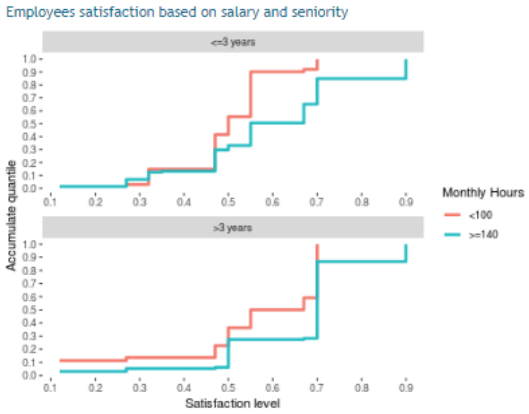


Figure 93: Employees Satisfaction Based on Salary and Seniority

Below we can see how the satisfaction of the employees behaves according to their seniority and their monthly hours. This chart has been implemented in R. As we can see, while the satisfaction level increases it's because the salary increases two.

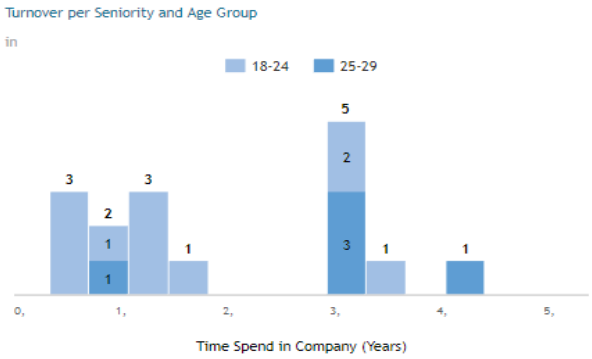


Figure 94: Turnover per Seniority and Age Group

We have reached the last chart of the Analytics tab. The chart relates the number of employees that have left the company basing on the Time Spend in Company and the Age Groups. In this case, the greatest of leavings have been due to employees who had been in the company for 3 years, being divided in 2 employees between 18 and 24 years old, and 3 employees between 25 and 29 years old.

6.2. Simulation

The main objective of the Simulation tab is to show in real time the employee's turnover percentage based on the different factors that can cause this variation. In addition, we can see for each employee which factor affects more and which factor affects less to decide if they stay in the company or they leave.

The header of the page is the same as the Simulation Tab, just changing the color of the tab we are in.

Figure 95: Talent Distribution

The first chart of this tab it's a table that distributes the employees of the company basing on their talent matching their potential and their performance. The box color shows if the number that is in that distribution is good, regular, or bad.

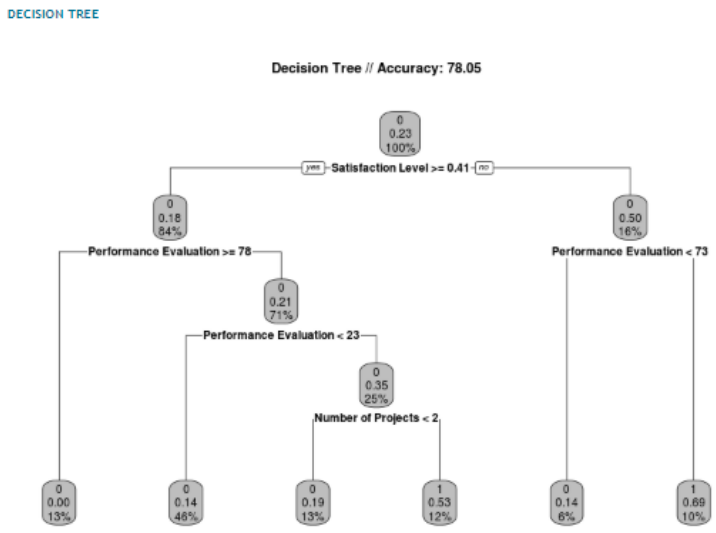


Figure 96: Decision Tree

The decision tree allows us to see in a very clear way the influence of the factors in the decision of leaving or staying in the company. From top to bottom, the tree is drilled down to reach the foot of the tree where we get the percentage of leaving or staying in the company through the above factors.

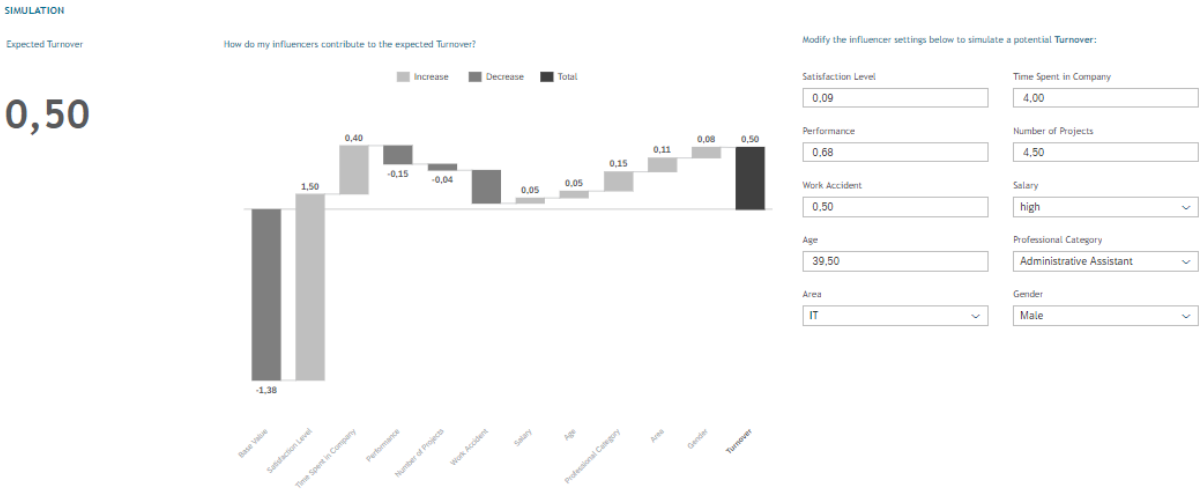


Figure 97: Simulation

In the central area of the Analytics tab, we find the main chart of the tab. The numerical value that appears on the left of the screen it's the value that will be modified as the influence factors that are on the right side of the chart change. The value of these factors can be changed through a scroll or by changing the numerical value manually. In the central area of the chart, it's shown how each factor contributes on the variation because not all will have the same effect. When there's a variation in the expected turnover, the numerical value is updated and next to it appears the percentage of variation that has occurred.

Figure 98: Predictive Filters

The last part of the dashboard is the one that will allow us to analyze the factors of influence at employee level. As we have many employees, first, there's this scroll filter area that will allow us to filter in case we were looking for a specific profile of employee.

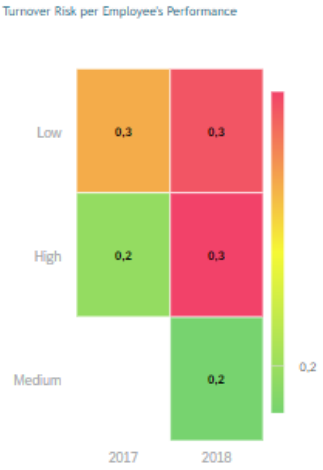


Figure 99: Turnover Risk per Employee's Performance

The first chart of the last three shows an annual comparison of the turnover risk for the different performance groups. The color indicates if the risk has increased or has decreased compared to the previous year, being red if the red has increased or being increasingly green if the risk has decreased.

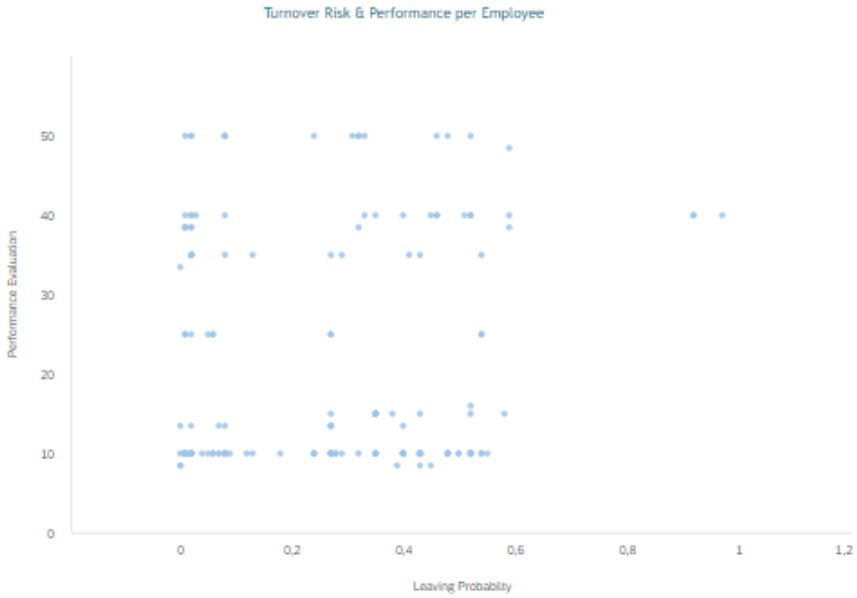


Figure 100: Turnover Risk & Performance per Employee

The central chart displays the distribution of employees based on leaving probability and performance evaluation. We also can see the turnover risk in each employee if we go on their round. This chart can also act as a filter to select a specific employee or group of employees and be able to see in the following chart how the factors affect to the leaving probability.

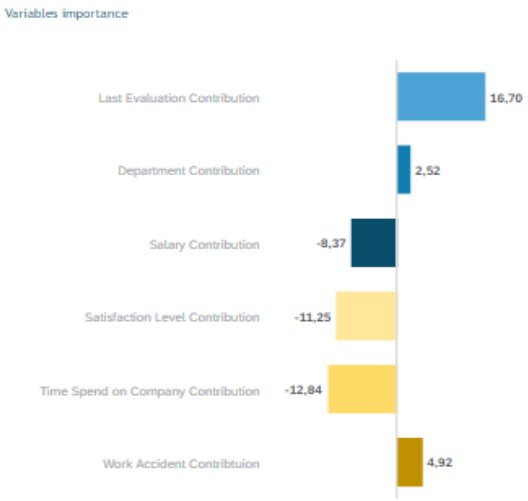


Figure 101: Variables importance

The last chart is the one that shows through a bars chart how the different variables contribute to the leaving probability, being negative if they don't matter and being more positive as they become more important. In this case it's seen a general view of the variables, but as we said in the previous chart, this information could be also seen individually for each employee.

6.3. Other Dashboard Functionalities

One of the strengths that SAP Analytics Cloud has is that it's a very alive and dynamic tool. Dashboards don't contain static graphs that gives simply information, quite the contrary because with most of the graphics we can interact, we can use them as filters, they can give us more information than what is actually seen on the screen, and others…For the moment, we've seen some functionalities like Predictive in time charts and variations between data in bar charts. Below are other functionalities that allow us the tool and charts.

6.3.1. Tooltips

A tooltip is a graphical user interface (GUI) element used in conjunction with the cursor or mouse pointer to display information about an item without needing to click on it. In our project, using a tooltip has been very useful to expand the information of each chart. Below we see two examples of where tooltip has been used in our project.

Figure 102: Tooltips(I)

This first chart is the one that showed us in the Analytics part the main reasons why the employees left the company. To get more information, if we put the cursor over one of the bars, we have added a tooltip to show the names of the employees who have left for that reason.

Figure 103: Tooltips (II)

This second chart is the one we showed in the Simulation tab that sows the risk of employee's turnover through their Performance and their Leaving Probability. As we can see in the image, when we put the cursor on one of the employees, we can see their name and exactly their values of the axes.

6.3.2. Chart filters

As we have said, the SAP Analytics Cloud charts are not simply images that give information because they are also on more element of the Dashboard with which to interact. It must be said that the only graphs that are not intractable are those that are implemented in R, but it's expected that in future updates this functionality can be added.

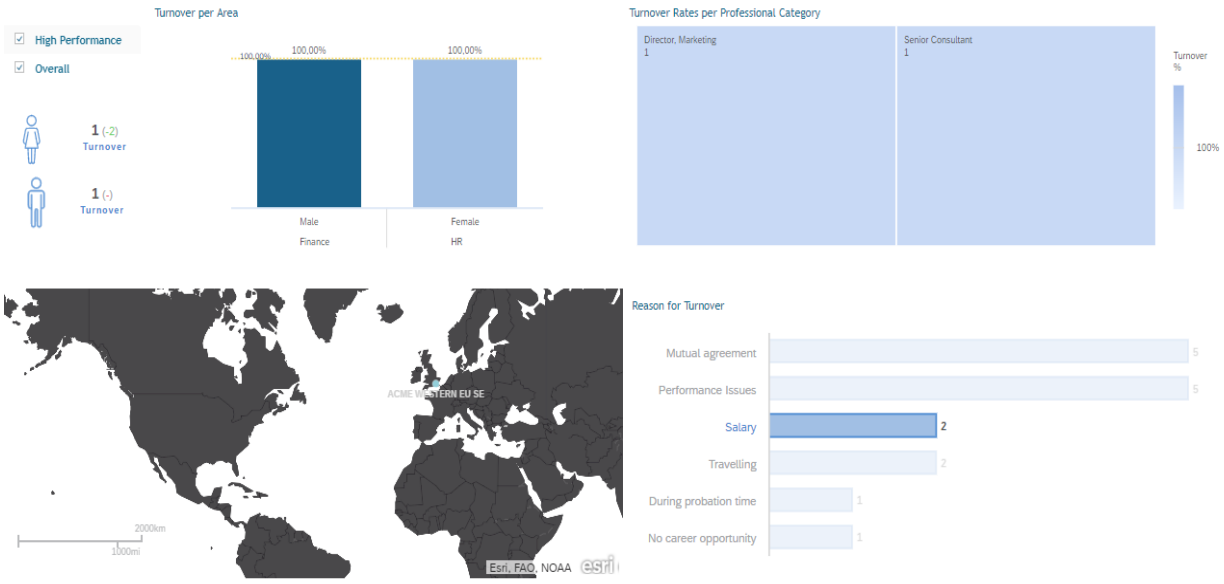


Figure 104: Chart Filters

We have selected part of the charts that are in the Analytics tab. As we can see in the chart of the reasons for turnover, we have selected to show us the information about the people who left the company due to the salary. Just clicking on the bar, automatically the dashboard refreshes showing the information for that reason. In this case, people who have left are a man and a woman, which one was Marketing Director and the other a Senior Consultant, and both belonged to the companies from Europe.

6.3.3. Search Insights

This is one of the tools we mentioned when we were talking about the main features of SAP Analytics Cloud. Our dashboard contains a lot and complete information, but it may be the case that we consider that we need other information. Search Insights allows to solve this problem, and through natural language and suggestions, draws the graph with the information we want. If the chart is what we expected, simply with one click the chart is added to the rest of existing graphs. The tool is located in the upper right corner of the dashboard, with a magnifying glass as a logo.

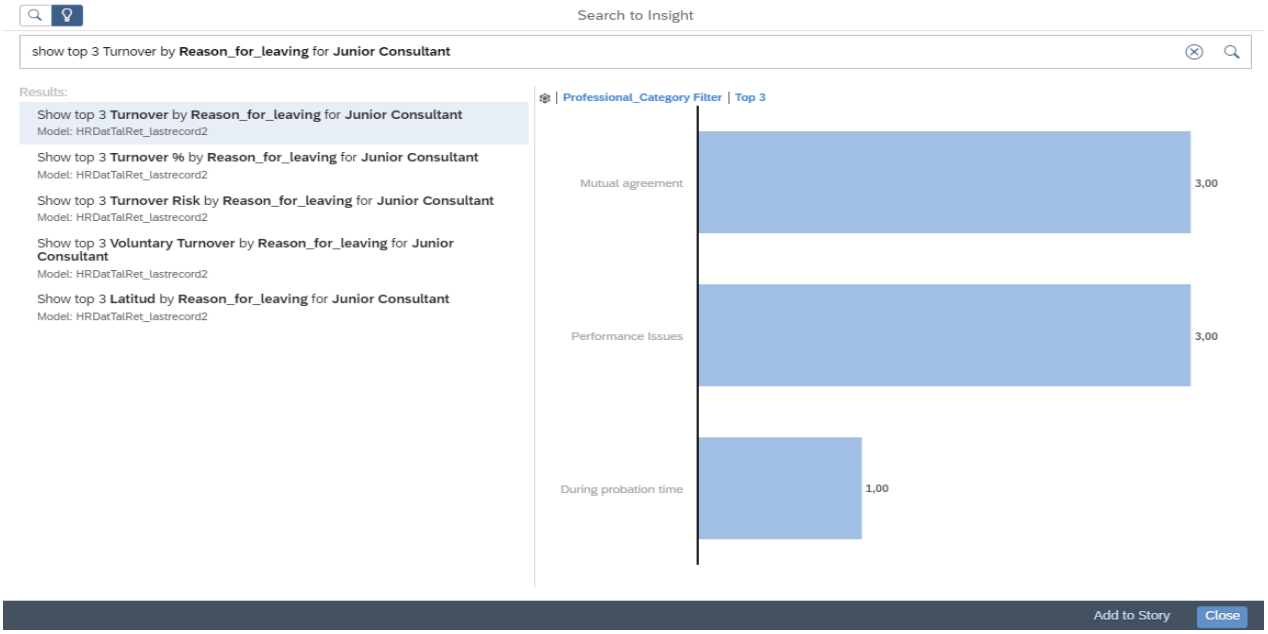


Figure 105: Search Insights

We have considered that we would like to see the main 3 reasons why the Junior consultants have left. To get this information, just by writing the text, the tool has proposed the chart that we see on the image, returning us the information. The main reasons why the juniors have left are mutual agreement,

performance issues and the finishing of the probation time. Pressing “Add to Story” button the chart would become one more chart of the Dashboard.

6.3.4. Smart Insights

Another tool that we presented in the SAP Analytics tools it was de Smart Insights. This tool allows us to get an answer for the reason that caused the variation or the origin of the value. It’s a very useful tool because we can get instantly this information through a chart explanation of the reason. To give more functionality to the tool, we go to the Headcount tab from the People Analytics dashboard, and are able to know the main reasons that have affected the value of the Terminations.

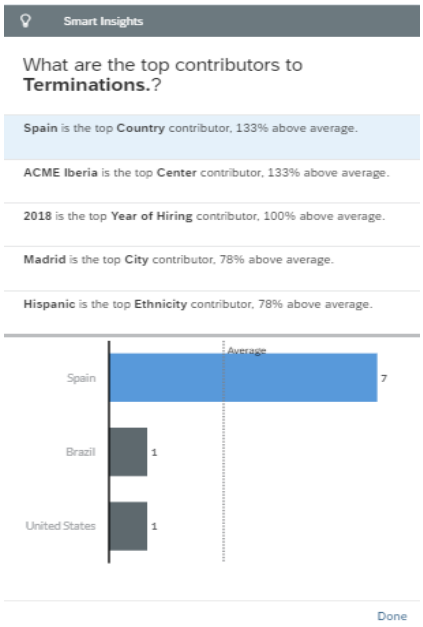


Figure 106: Smart Insights(I)

Just clicking on the KPI value, a light bulb appears. If we click on this light bulb, it appears this box that gives us the main contributors of the value of the terminations. In this case, we see that the main reason it’s the country of the employees, where Spain is the top contributor with a 133% above the average. In Spain there have been 7 terminations from 9 of the totals. We can still go further and make again Smart Insights in the country bar the see the reasons for the 7 terminations. A new Smart Discovery is generated again, and this one gives us the information that the main reasons are due to the fact that 3 Marketing Manager have left in this country.

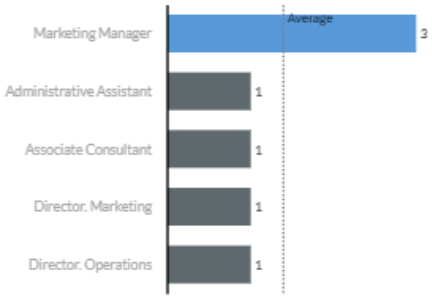


Figure 107: Smart Insights (II)

6.3.5. Smart Discovery

During the explanation of the charts of the Analytics tab, we talked about the Turnover Risk, but maybe we consider that we are missing some information or we want to study this variable in more detail. Thanks to Smart Discovery, in less than a minute, it's generated a new Dashboard with 4 tabs (Overview, Key Influencers, Unexpected Values and Simulation) that will give us all the information about this variable.

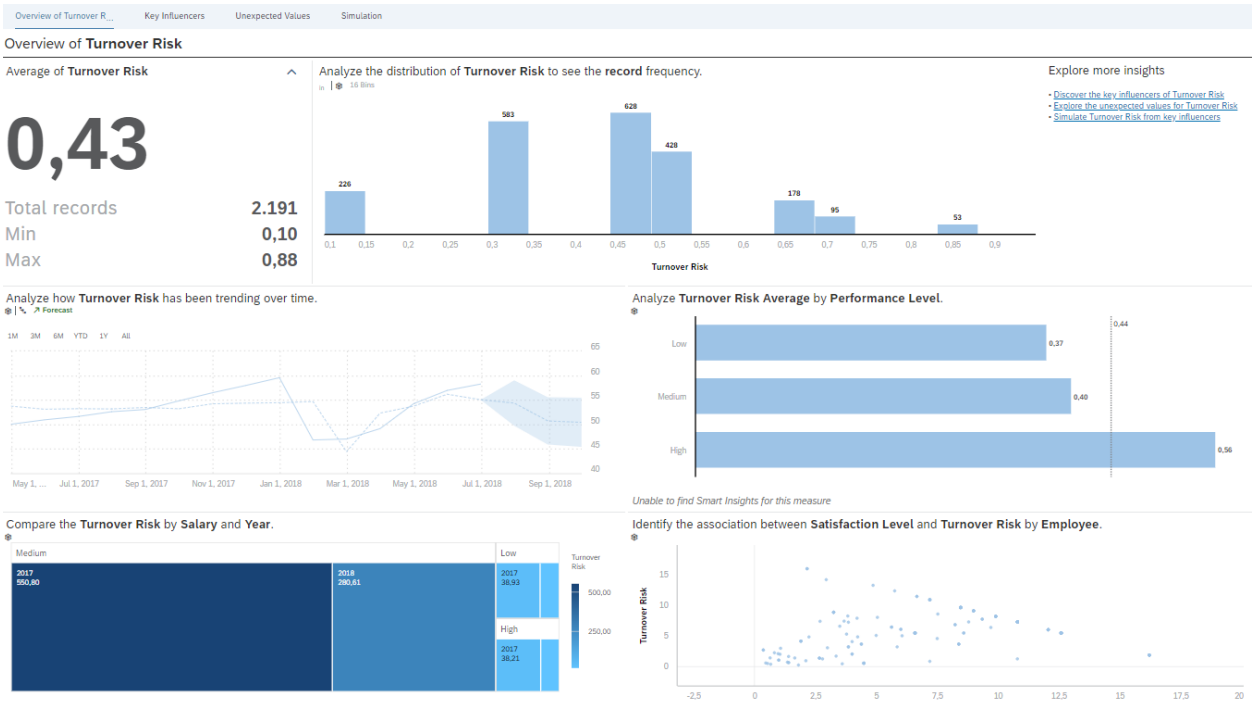


Figure 108: Smart Discovery Overview Tab

The first tab of the Smart Discovery dashboard is called Overview. As the name says, this page displays a summary of the turnover risk value and its temporal evolution. In the temporal series chart, there is also added a prediction of the value that the risk can reach in the coming months. Finally, we can see a distribution of the turnover risk according to the Year and the Salary, and the distribution of the employees according to the Turnover Risk and the Satisfaction Level.

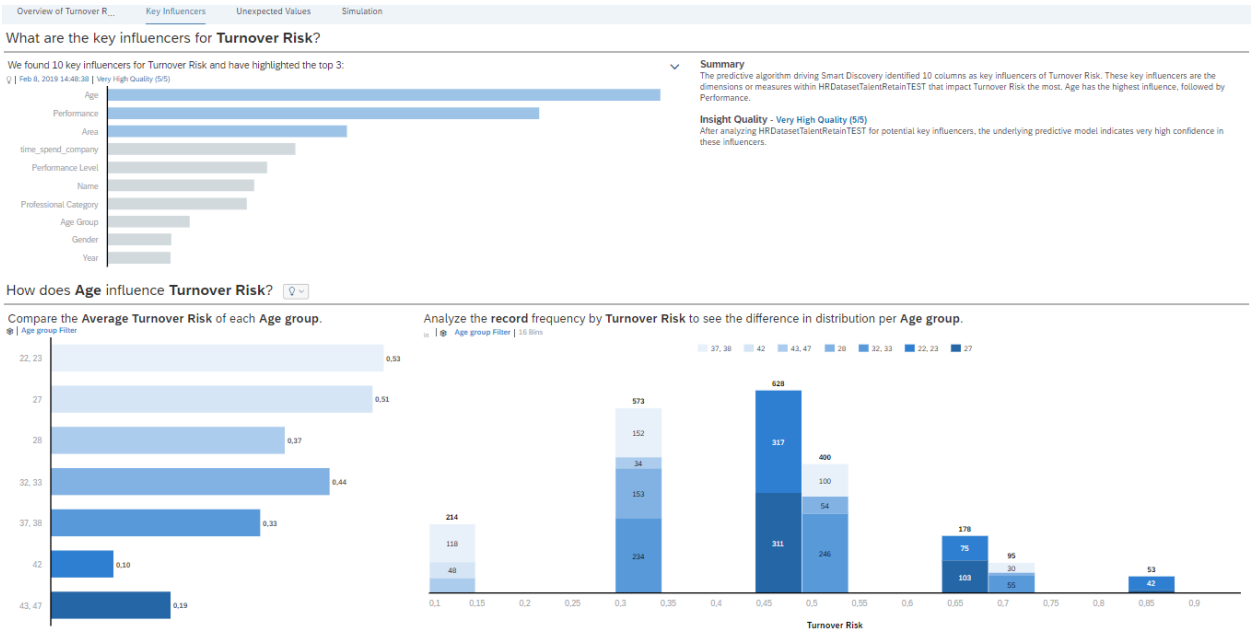


Figure 109: Smart Discovery Key Influencers Tab

The second tab, named Key Influencers, informs about the factors that most affect the turnover risk. We see that the main reason is the Age, followed by the Performance and the Area. From these three most influential factors, the tool displays a comparison of the turnover risk for each of them. In the image we see how does age affect the turnover risk, being higher among young employees.

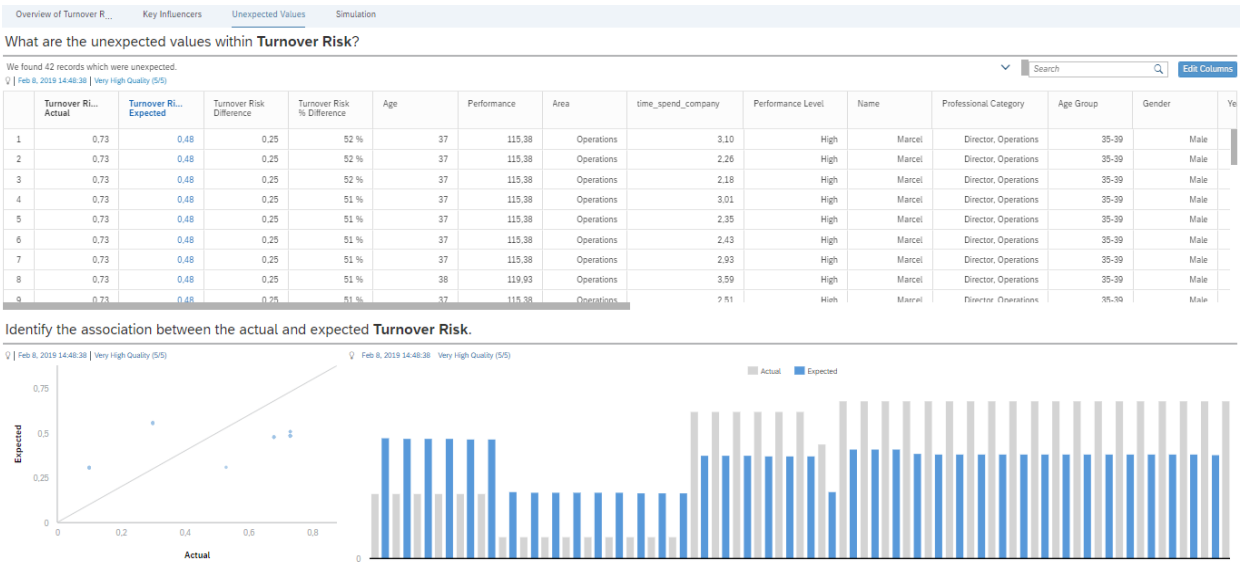


Figure 110: Smart Discovery Unexpected Values Tab

The Unexpected Values tab displays those values that, based on the data and the trend of the previous months, have deviated from the expected value. The chart and the table show each of these records and they offer detailed information for each one of them.

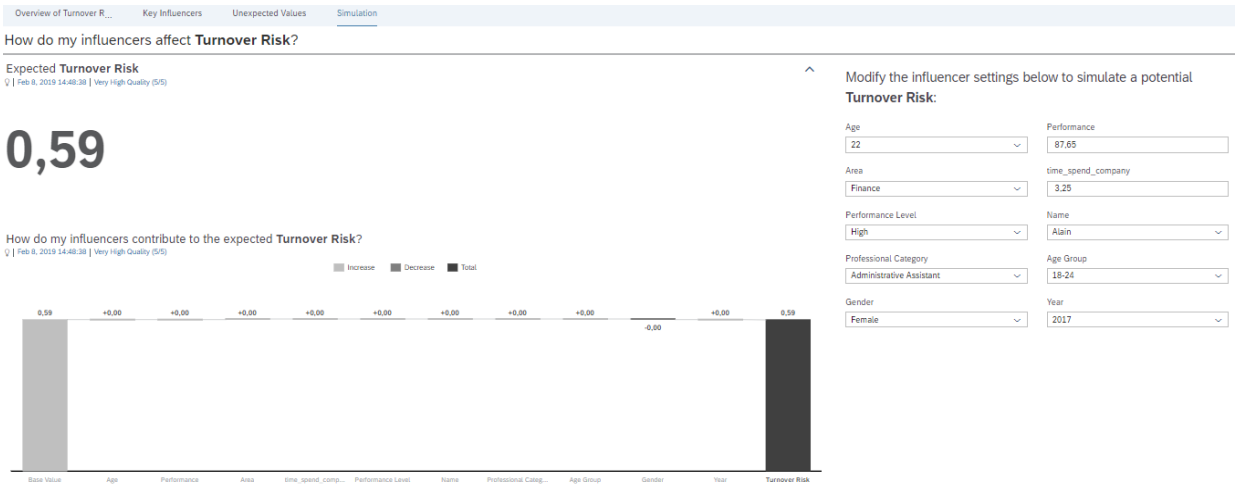


Figure 111: Smart Discovery Simulation Tab

The last tab of the Smart Discovery is the Simulation tab, which allows us, through the key influencers, to see the real value and the percentage variation of the turnover risk. It's important to know the factors that influence more or influence less to know the degree of variation of the turnover risk value.

6.3.6. Other Functionalities

During the Dashboard elaboration, other functionalities of the SAP Analytics Cloud that have been mentioned while charts were explained, or other functionalities that have not been mentioned. These are other functionalities that the tool offers us.

- **Forecasting:** we have seen this utility several in time charts, and it's very powerful since it gives a prediction of the future value through the previous data. From this value, companies can adjust its planning values and make business decisions.

- **Jump to another page:** through a chart, we can jump to another page. In our dashboard, exactly in the char that refers to the turnover according to the professional category, if we click on it we have the option to jump to another page with the detailed information of the employees. The only way to access to this page it's by this chart.

- **Sort and show top values:** sometimes, charts don't show the information sorted or they show a high number of results that doesn't allow us taking conclusions from the chart. In this way, we have the option to sort the charts ascending or descending, or show top or bottom N results.

- **Variation:** this is one of the functionalities that we also have seen during the dashboard explanation. After setting the Time dimension we want, the tool offers the possibility of showing the differences from the previous period. This period could be day, month, quarter or year.

- **Threshold:** there's sometimes that we need more colors to represent charts and understand better the result. With this functionality we can establish a ladder of colors depending on the different values that a chart can obtain.

6.4. Dashboard Screenshots

The charts above ara located in the application so that the user can interact and navigate with it without problems. In this way, in this section are shown the screenshots of the application with which the user interacts and where we see how each graph is placed in the dashboard. Through a scroll, the users can visualize the information of the charts in function of the different subsections and the different types of chart.

6.4.1. Analytics

Next, the charts visualization and the user interface of the Analytics tab.

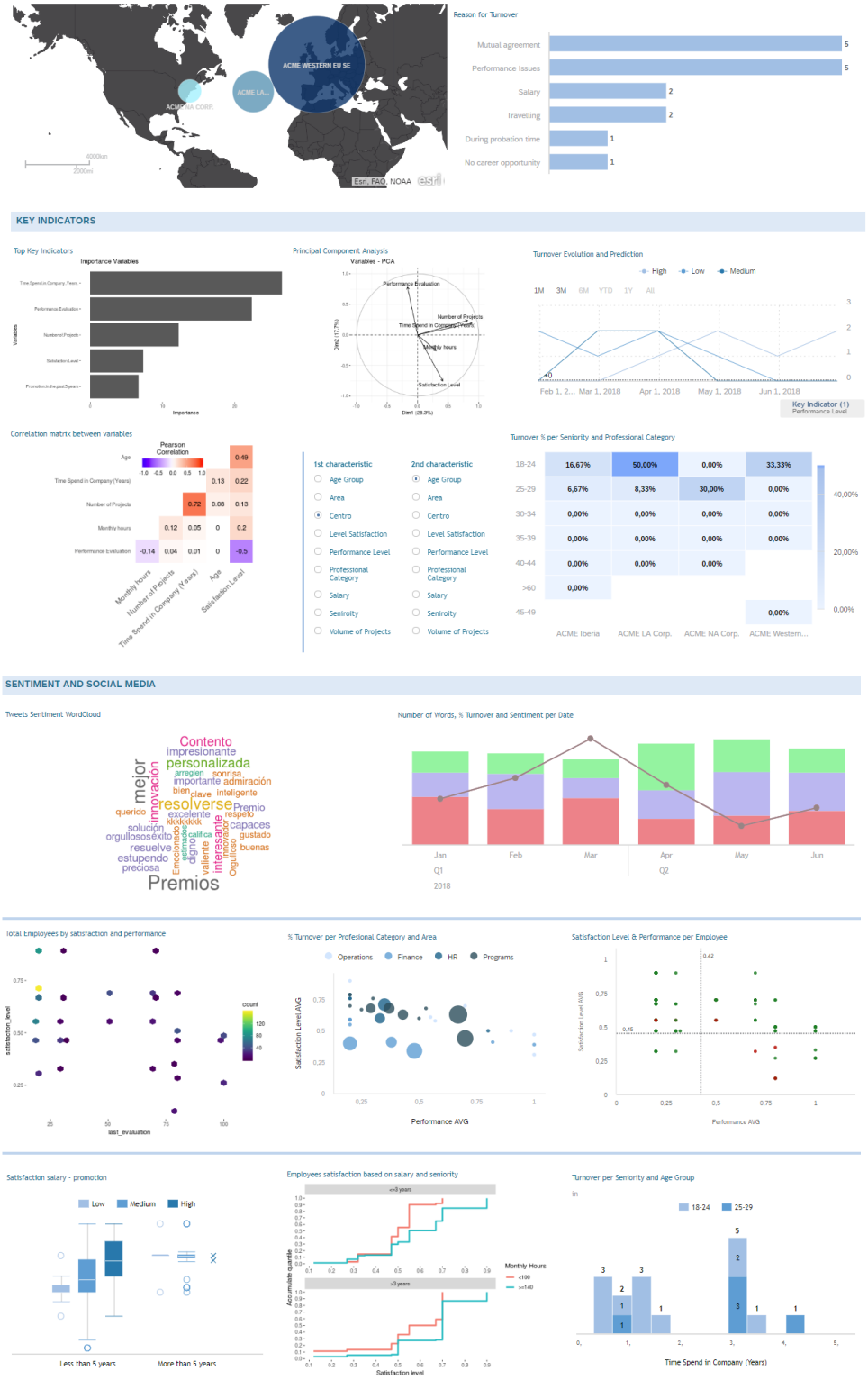


Figure 112: Turnover Analytics Tab

6.4.2. Simulation

Second, the user interface of the Simulation tab, where we also can see how the charts are distributed in the dashboard.

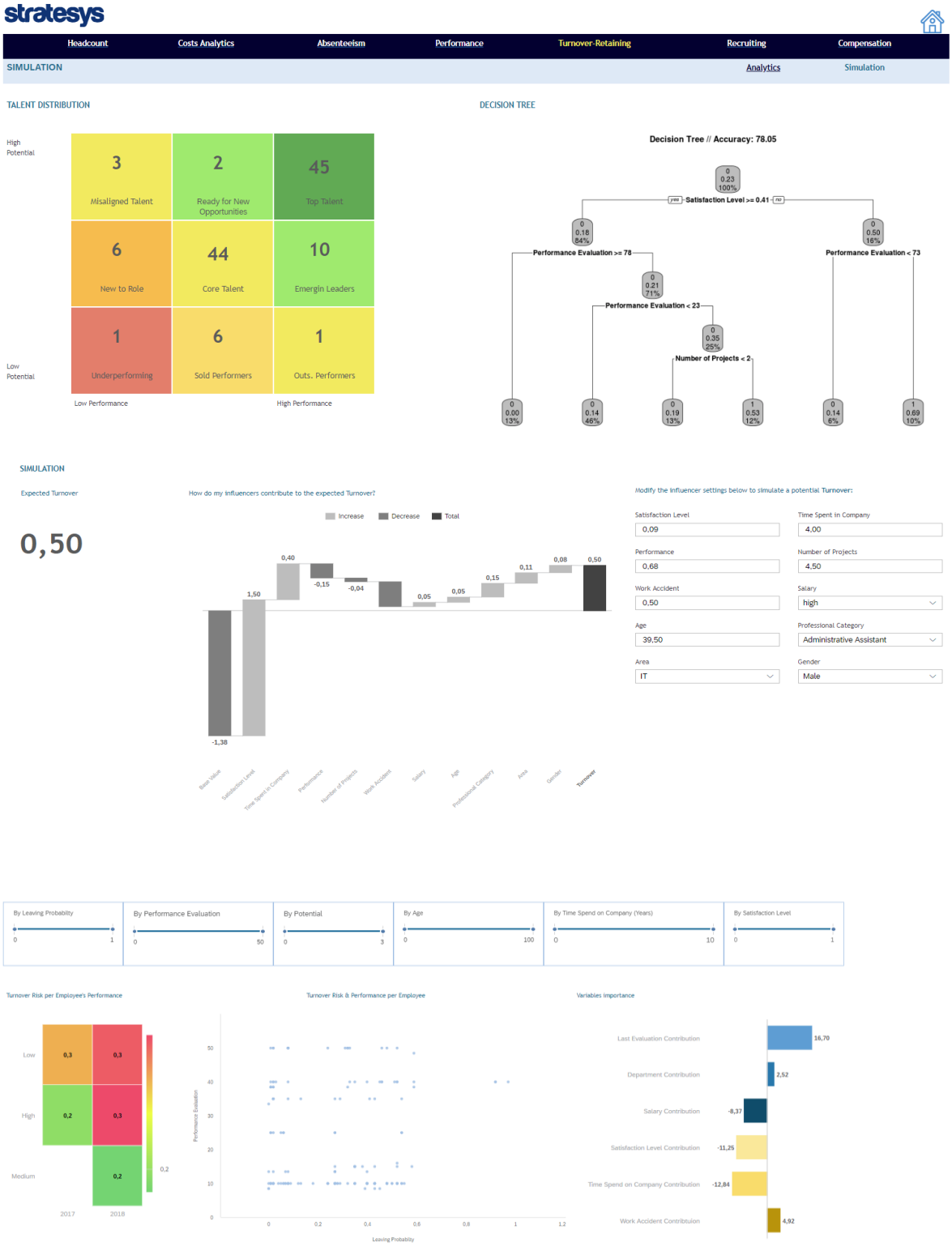


Figure 113: Turnover Simulation Tab

7 General Conclusions and Future Work

In this section, it is summarized the work that we've done since the beginning, the conclusions about the main objectives we defined in the initial phases of the project, and the future steps to keep developing the tool, start new projects and sell it to companies.

7.1. Conclusion

The Turnover tab, from the People Analytics Dashboard, has been developed to answer all the questions about the turnover and the high-performance turnover employees. In Stratesys we understand the importance of the young-talented people in the business world, so we've developed this tool to help all kind of companies to prevent these leavings and maximize its employees' potential.

To implement this project, what we've needed has been each employee information, starting from its personal information as name, city, job role…, and finishing with the time spend in company, the average monthly hours, satisfaction… Once we had this information, thanks to SAP Analytics Cloud we have been able to develop this interactive and usable application that everybody can understand and interact with it. During the project explanation we have been able to answer all kind of questions with just looking a chart or interacting with it, and through the tool functionalities, we had the opportunity to see a prediction of the future values according to the historical data. All these functionalities help companies to make decisions and plan their business through this information. In our case we've worked with an unofficial dataset, but the project is ready work with a real one just changing the data.

On a personal level, I think that the development of the application has helped me to grow both personally and professionally. As I said in the initial parts of the project, this has been my first project outside the university, that has meant a higher responsibility and start working in a different way that I've been used until now. Once the design is finished, my personal conclusions are very positive and I think that we've developed a high-potential tool that will be liked by many of the business companies.

7.2. Future Work

One of the strong aspects of our application is that is not a closed application, that means that has the objective of adapting to the different business that decide to work with it. This application has been an internal project of the company, but the main idea is to start distributing it among companies and adapt it to each business idea to offer the information in a personalized way. From our company we understand that not all companies have or want the same information, so we have developed a standard prototype that can be adapted to any company.

The application can also act as a base to start new internal projects and expand the tool functionalities. SAP Analytics Cloud is updated every few weeks, so it's always interesting to see if the new updates can provide us new features that we can add into the project. Apart from this, we can also work with the current project modifying the data to find use cases that can also be solved through the application. In summary, People Analytics is a starting point to go further and continue developing and enhancing the tool.

Finally, once the project is finished, it can't be launched into the market without obtain an official SAP Qualification. In the following image are shown the different steps that all projects that use SAP technology have to follow to be qualified for distribution and sale.

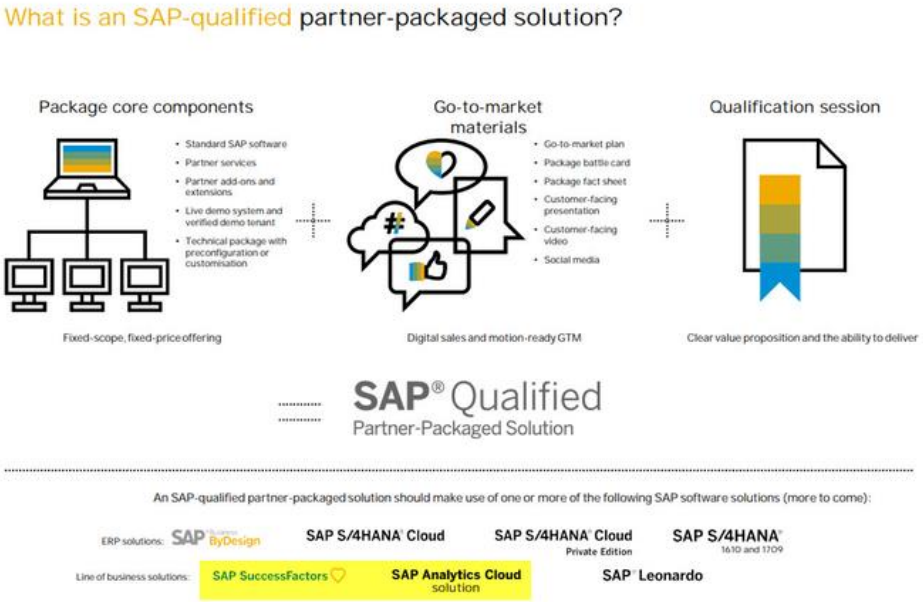


Figure 114: SAP Qualify Process

The 21st of March of 2019, SAP certified the People Analytics Solution. Some of the key features and identity that define our SAP Qualified Partner-Packaged Solution are:

- Advanced analytics of the employees through predictive algorithms and machine learning to improve talent retention.

- Analysis of employee's sentiment and social networks to determine their effects on Human Resources management.

- Comparison with the market averages, budget and historical evaluation to analyse performance.

8 Bibliography

[1] Guru99, "Introduction SAP BI," 25 May 2019. [Online]. Available: https://www.guru99.com/introduction-sap-bi.html.

[2] SAP, "Business intelligence (BI) solutions," 25 May 2019. [Online]. Available: https://www.sap.com/products/analytics/business-intelligence-bi.html.

[3] EAE, "Retos de la empresa familiar," 25 May 2019. [Online]. Available: https://www.eaeprogramas.es/empresa-familiar/5-softwares-de-sistemas-de-gestion-que-debes-conocer.

[4] Wikipedia, "Microsoft Dynamics," 20 May 2019. [Online]. Available: https://es.wikipedia.org/wiki/Microsoft_Dynamics.

[5] G. Anaya, "SAC vs Power BI," Internal Project, 05 20 2019. [Online].

[6] Stratesys, "Stratesys," 16 April 2019. [Online]. Available: https://www.stratesys-ts.com/en/.

[7] Indra, "About Indra," 17 April 2019. [Online]. Available: https://www.indracompany.com/en/indra.

[8] Everis, "About us," 17 April 2019. [Online]. Available: https://www.everis.com/global/en/about-us.

[9] Accenture, "About Accenture," 17 April 2019. [Online]. Available: https://www.accenture.com/us-en/about/company-index.

[10] SAP, "SAP Company Information," 19 April 2019. [Online]. Available: https://www.sap.com/corporate/en/company.html.

[11] SAP, "Why SAP?," 19 April 2019. [Online]. Available: https://www.sap.com/why-sap.html.

[12] SAP, "SAP Analytics Cloud," 19 April 2019. [Online]. Available: https://www.sap.com/products/cloud-analytics.html.

[13] SAP, "Stratesys SAP Analytics Cloud," SAP, [Online]. Available: https://stratesys-ts.eu1.sapbusinessobjects.cloud.

[14] SAP, "Data Preparation in SAP Analytics Cloud," 20 April 2019. [Online]. Available: https://www.youtube.com/watch?v=OKJpkBzlgI0.

[15] SAP, "Step-by-Step Guide: Creating a SAP Analytics Cloud (Formerly SAP BusinessObjects Cloud/SAP Cloud for Analytics/C4A) Analytic Model by importing data from Excel," 21 April

2019. [Online]. Available: https://blogs.sap.com/2016/05/09/step-by-step-instructions-creating-an-analytical-model-by-importing-data-from-excel/.

[16] SAP, "Introduction to Data Models in SAP Analytics Cloud," 21 April 2019. [Online]. Available: https://www.sapanalytics.cloud/resources-data-modeling/.

[17] Stratesys, «Documentación final,» 25 May 2019. [En línea].

[18] SAP Success Factors, "SAP SuccessFactors: Human resource management in the cloud," 25 May 2019. [Online]. Available: https://www.successfactors.com/index.html.

[19] Robert Walters, "About us," 23 May 2019. [Online]. Available: https://www.robertwalters.com/careers/about-us.html.

[20] Michael Page, "About us," 23 May 2019. [Online]. Available: https://www.michaelpage.es/about-us.

[21] Hays, "About us," 23 May 2019. [Online]. Available: https://www.hays.co.uk/about-hays/index.htm.

[22] Randstad, "About Randstad," 23 May 2019. [Online]. Available: https://www.randstad.com/about-randstad/.

[23] S. Shukla, "Integrating Twitter with SAP HANA for Text Analysis," SAP, 17 December 2019. [Online]. Available: https://blogs.sap.com/2017/06/07/integrating-twitter-with-sap-hana-for-text-analysis/.

[24] Stratesys, "HR Insights by Stratesys," 6 June 2019. [Online]. Available: https://www.stratesys-ts.com/es/hr-insights-nuestra-nueva-packaged-solution-certificada-sap/.

9 Annexes

In this section we show the three datasets that we have uploaded to the SAP Analytics Cloud to build the charts and design de application. The information of the documents is fictious and has been prepared to show functional business cases that can be seen through the application.

9.1. Talent Retain Dataset

This Dataset Contains the main information of the application and the source of the most of the charts of the application. Due to the size of the file and the high number of columns, the information of this Dataset it's shown splitted by different groups of columns.

- Columns A – I

	A	B	C	D	E	F	G	H	I
1	Date	Year	Month	UserId	Name	Surname	Full Name	Active	satisfaction_level
2	31/01/2017	2017	1	A034	Fernando	Verdasco	Fernando Ve	True	0,47
3	28/02/2017	2017	2	A034	Fernando	Verdasco	Fernando Ve	True	0,47
4	31/03/2017	2017	3	A034	Fernando	Verdasco	Fernando Ve	True	0,47
5	30/04/2017	2017	4	A034	Fernando	Verdasco	Fernando Ve	True	0,47
6	31/05/2017	2017	5	A034	Fernando	Verdasco	Fernando Ve	True	0,47
7	30/06/2017	2017	6	A034	Fernando	Verdasco	Fernando Ve	True	0,47
8	31/07/2017	2017	7	A034	Fernando	Verdasco	Fernando Ve	True	0,47
9	31/08/2017	2017	8	A034	Fernando	Verdasco	Fernando Ve	True	0,47
10	30/09/2017	2017	9	A034	Fernando	Verdasco	Fernando Ve	True	0,47
11	31/10/2017	2017	10	A034	Fernando	Verdasco	Fernando Ve	True	0,47
12	30/11/2017	2017	11	A034	Fernando	Verdasco	Fernando Ve	True	0,47
13	31/12/2017	2017	12	A034	Fernando	Verdasco	Fernando Ve	True	0,47
14	31/01/2018	2018	1	A034	Fernando	Verdasco	Fernando Ve	True	0,47
15	28/02/2018	2018	2	A034	Fernando	Verdasco	Fernando Ve	True	0,47
16	31/03/2018	2018	3	A034	Fernando	Verdasco	Fernando Ve	True	0,47
17	30/04/2018	2018	4	A034	Fernando	Verdasco	Fernando Ve	True	0,47
18	31/05/2018	2018	5	A034	Fernando	Verdasco	Fernando Ve	True	0,47
19	30/06/2018	2018	6	A034	Fernando	Verdasco	Fernando Ve	True	0,47
20	31/01/2017	2017	1	can2	Dennis	Sutton	Dennis Sutto	True	0,7
21	28/02/2017	2017	2	can2	Dennis	Sutton	Dennis Sutto	True	0,7
22	31/03/2017	2017	3	can2	Dennis	Sutton	Dennis Sutto	True	0,7
23	30/04/2017	2017	4	can2	Dennis	Sutton	Dennis Sutto	True	0,7
24	31/05/2017	2017	5	can2	Dennis	Sutton	Dennis Sutto	True	0,7
25	30/06/2017	2017	6	can2	Dennis	Sutton	Dennis Sutto	True	0,7

Figure 115: Talent Retain Dataset (Columns A-I)

J	K	L	M	N	O	P	Q	R	S
last_evaluation	performance_level	number_project	average_montly_hours	time_spend_company	Work_accident	left	promotion_last_5years	department	salary
96,92	High	1	80	0,13	0	0	0	Operations	High
96,92	High	1	80	0,21	0	0	0	Operations	High
96,92	High	1	80	0,29	0	0	0	Operations	High
96,92	High	1	80	0,37	0	0	0	Operations	High
96,92	High	1	80	0,46	0	0	0	Operations	High
96,92	High	1	80	0,54	0	0	0	Operations	High
96,92	High	1	80	0,62	0	0	0	Operations	High
96,92	High	1	80	0,71	0	0	0	Operations	High
96,92	High	2	80	0,79	0	0	0	Operations	High
96,92	High	2	80	0,88	0	0	0	Operations	High
96,92	High	2	80	0,96	0	0	0	Operations	High
96,92	High	2	80	1,04	0	0	0	Operations	High
99,95	High	1	80	1,13	0	0	0	Operations	High
99,95	High	2	80	1,2	0	0	0	Operations	Medium
99,95	High	2	80	1,29	0	0	0	Operations	Medium
99,95	High	2	80	1,37	0	0	0	Operations	Medium
99,95	High	2	80	1,46	0	0	0	Operations	Medium
99,95	High	2	80	1,54	0	1	0	Operations	High
76,92	High	2	160	3,08	0	0	1	Programs	High
76,92	High	2	160	3,16	0	0	1	Programs	High
76,92	High	2	160	3,24	0	0	1	Programs	High
76,92	High	2	160	3,33	0	0	1	Programs	High
76,92	High	2	160	3,41	0	0	1	Programs	High
76,92	High	3	160	3,49	0	0	1	Programs	High
76,92	High	3	160	3,58	0	0	1	Programs	High

Figure 116: Talent Retain Dataset (Columns J-S)

T	U	V	W	X	Y	Z
Gender	Age	age_range	Professional_Category	Reason_for_leaving	voluntary_turnover	leaving_probability
Male	62	>60	Associate Consultant		0	0,53
Male	62	>60	Associate Consultant		0	0,53
Male	62	>60	Associate Consultant		0	0,53
Male	62	>60	Associate Consultant		0	0,53
Male	62	>60	Associate Consultant		0	0,53
Male	62	>60	Associate Consultant		0	0,53
Male	62	>60	Associate Consultant		0	0,53
Male	62	>60	Associate Consultant		0	0,53
Male	62	>60	Associate Consultant		0	0,53
Male	62	>60	Associate Consultant		0	0,53
Male	62	>60	Associate Consultant		0	0,53
Male	62	>60	Associate Consultant		0	0,53
Male	63	>60	Associate Consultant		0	0,53
Male	63	>60	Associate Consultant		0	0,53
Male	63	>60	Associate Consultant		0	0,53
Male	63	>60	Associate Consultant		0	0,53
Male	63	>60	Associate Consultant		0	0,53
Male	63	>60	Associate Consultant	Performance Issues	0	0,53
Male	47	45-49	Analyst, Professional Services		0	0,3
Male	47	45-49	Analyst, Professional Services		0	0,3
Male	47	45-49	Analyst, Professional Services		0	0,3
Male	47	45-49	Analyst, Professional Services		0	0,3
Male	47	45-49	Analyst, Professional Services		0	0,3
Male	47	45-49	Analyst, Professional Services		0	0,3

Figure 117: Talent Retain Dataset (Columns T-Z)

9.2. Benchmarking Dataset

The information below it's the one we have used to compare our data with the Benchmarking ones.

	B	C	D	E	F	G	H	I	J
1	GENDER	SOURCE	Employee tenure (years)	Overall turnover rate %	Voluntary turnover rate %	Involuntary turnover rate %	High-performer turnover rate %	Promotion rate %	Salary increase %
2	MAN	Robert Walters	8	0,18	0,13	0,06	0,03	0,06	0,03
3	WOMAN	Robert Walters	7	0,15	0,13	0,05	0,05	0,07	0,05
4	MAN	Robert Walters	11	0,16	0,13	0,06	0,01	0,05	0,05
5	WOMAN	Robert Walters	6	0,17	0,13	0,06	0,05	0,05	0,01
6	MAN	Robert Walters	10	0,18	0,13	0,06	0,05	0,05	0,03
7	WOMAN	Robert Walters	11	0,18	0,12	0,05	0,05	0,06	0,04
8	MAN	Michael Page	10	0,16	0,13	0,05	0,02	0,06	0,02
9	WOMAN	Michael Page	7	0,16	0,13	0,06	0,04	0,06	0,01
10	MAN	Michael Page	10	0,18	0,14	0,05	0,01	0,06	0,04
11	WOMAN	Michael Page	11	0,19	0,14	0,06	0,04	0,05	0,03
12	MAN	Michael Page	10	0,15	0,12	0,07	0,03	0,06	0,03
13	WOMAN	Michael Page	10	0,19	0,14	0,06	0,05	0,05	0,02
14	MAN	Hays	11	0,19	0,12	0,06	0,03	0,07	0,02
15	WOMAN	Hays	9	0,18	0,14	0,05	0,04	0,07	0,06
16	MAN	Hays	11	0,19	0,14	0,06	0,02	0,05	0,04
17	WOMAN	Hays	10	0,19	0,12	0,06	0,03	0,05	0,06
18	MAN	Hays	9	0,18	0,13	0,06	0,03	0,05	0,02
19	WOMAN	Hays	11	0,18	0,14	0,06	0,03	0,07	0,01
20	MAN	Randstad	9	0,19	0,14	0,07	0,01	0,06	0,01
21	WOMAN	Randstad	9	0,15	0,12	0,06	0,03	0,05	0,06
22	MAN	Randstad	10	0,16	0,13	0,07	0,04	0,05	0,01
23	WOMAN	Randstad	11	0,15	0,13	0,05	0,05	0,05	0,01
24	MAN	Randstad	7	0,17	0,12	0,06	0,03	0,05	0,02
25	WOMAN	Randstad	6	0,17	0,14	0,07	0,01	0,07	0,06

Figure 118: Benchmarking Dataset

9.3. Social Media Dataset

	A	B	C	D	E	F	G
1	CREATED_AT	ID	USER_NAME	TEXT	TA_TYPE	TA_TOKEN	TA_COUNTER_SUM
2	09/11/2018	1.600	Jesús Álvarez-Cascos	RT @stratesys: #PeopleAnalytics by @stratesys proporciona a los equipos de RRHH datos clave, completos y seguros para tomar decisiones ágil...	WeakPositiveSentiment	ágil	8
3	09/11/2018	1.759	Jesús Álvarez-Cascos	RT @stratesys: #PeopleAnalytics by @stratesys proporciona a los equipos de RRHH datos clave, completos y seguros para tomar decisiones ágil...	WeakPositiveSentiment	ágil	8
4	09/11/2018	1.918	Jesús Álvarez-Cascos	RT @stratesys: #PeopleAnalytics by @stratesys proporciona a los equipos de RRHH datos clave, completos y seguros para tomar decisiones ágil...	WeakPositiveSentiment	ágil	8
5	10/11/2018	1.598	Nayade Ortiz	Gracias @stratesys , por apoyar este tipo de eventos. Olé y ole. #AlmadénPorHaiti #CarreraPopular https://t.co/oa4QdE4YKO	WeakPositiveSentiment	apoyar	3
6	10/11/2018	1.757	Nayade Ortiz	Gracias @stratesys , por apoyar este tipo de eventos. Olé y ole. #AlmadénPorHaiti #CarreraPopular https://t.co/oa4QdE4YKO	WeakPositiveSentiment	apoyar	3
7	10/11/2018	1.916	Nayade Ortiz	Gracias @stratesys , por apoyar este tipo de eventos. Olé y ole. #AlmadénPorHaiti #CarreraPopular https://t.co/oa4QdE4YKO	WeakPositiveSentiment	apoyar	3
8	10/11/2018	2.081	Nayade Ortiz	Gracias @stratesys , por apoyar este tipo de eventos. Olé y ole. #AlmadénPorHaiti #CarreraPopular https://t.co/oa4QdE4YKO	WeakPositiveSentiment	apoyar	3
9	10/11/2018	2.243	Nayade Ortiz	Gracias @stratesys , por apoyar este tipo de eventos. Olé y ole. #AlmadénPorHaiti #CarreraPopular https://t.co/oa4QdE4YKO	WeakPositiveSentiment	apoyar	3
10	10/11/2018	2.405	Nayade Ortiz	Gracias @stratesys , por apoyar este tipo de eventos. Olé y ole. #AlmadénPorHaiti #CarreraPopular https://t.co/oa4QdE4YKO	WeakPositiveSentiment	apoyar	3
11	12/11/2018	1.579	Lorena Martín	RT @j_a_cascos: #ASUG #COLOMBIA 2018 - Mañana estaremos en #Bogotá con nuestro cliente @oBoticario en la conferencia magistral 'La transfor...	StrongPositiveSentiment	magistral	10
12	12/11/2018	1.581	stratesys	RT @j_a_cascos: #ASUG #COLOMBIA 2018 - Mañana estaremos en #Bogotá con nuestro cliente @oBoticario en la conferencia magistral 'La transfor...	StrongPositiveSentiment	magistral	10
13	12/11/2018	1.583	Yolanda Vaquero	RT @stratesys: Congreso #ASUG #COLOMBIA 2018 - El 13-NOV acompañaremos a nuestro cliente @oBoticario en la conferencia magistral 'La transf...	StrongPositiveSentiment	magistral	9
14	12/11/2018	1.588	Yolanda Vaquero	RT @j_a_cascos: @stratesys #Webinars - Compra estratégica con @SAPAriba Sourcing - Hoy nuestros expertos #Procurement han compartido con nu...	StrongPositiveSentiment	expertos	9
15	12/11/2018	1.589	Yolanda Vaquero	RT @stratesys: #PeopleAnalytics by @stratesys proporciona a los equipos de RRHH datos clave, completos y seguros para tomar decisiones ágil...	WeakPositiveSentiment	ágil	8
16	12/11/2018	1.591	Yolanda Vaquero	RT @stratesys: Este fin de semana hemos estado en #Almadén apoyando a la Asociación de Antiguos Alumnos de la @Esc_Ing_Almaden y al @aytoal...	WeakPositiveSentiment	apoyando	6
17	12/11/2018	1.593	Lorena Martín	RT @stratesys: #PeopleAnalytics by @stratesys proporciona a los equipos de RRHH datos clave, completos y seguros para tomar decisiones ágil...	WeakPositiveSentiment	ágil	8
18	12/11/2018	1.594	Lorena Martín	RT @stratesys: Este fin de semana hemos estado en #Almadén apoyando a la Asociación de Antiguos Alumnos de la @Esc_Ing_Almaden y al @aytoal...	WeakPositiveSentiment	apoyando	6
19	12/11/2018	1.597	Jesús Álvarez-Cascos	RT @stratesys: Este fin de semana hemos estado en #Almadén apoyando a la Asociación de Antiguos Alumnos de la @Esc_Ing_Almaden y al @aytoal...	WeakPositiveSentiment	apoyando	6
20	12/11/2018	1.738	Lorena Martín	RT @j_a_cascos: #ASUG #COLOMBIA 2018 - Mañana estaremos en #Bogotá con nuestro cliente @oBoticario en la conferencia magistral 'La transfor...	StrongPositiveSentiment	magistral	10
21	12/11/2018	1.740	stratesys	RT @j_a_cascos: #ASUG #COLOMBIA 2018 - Mañana estaremos en #Bogotá con nuestro cliente @oBoticario en la conferencia magistral 'La transfor...	StrongPositiveSentiment	magistral	10
22	12/11/2018	1.742	Yolanda Vaquero	RT @stratesys: Congreso #ASUG #COLOMBIA 2018 - El 13-NOV acompañaremos a nuestro cliente @oBoticario en la conferencia magistral 'La transf...	StrongPositiveSentiment	magistral	9
23	12/11/2018	1.747	Yolanda Vaquero	RT @j_a_cascos: @stratesys #Webinars - Compra estratégica con @SAPAriba Sourcing - Hoy nuestros expertos #Procurement han compartido con nu...	StrongPositiveSentiment	expertos	9
24	12/11/2018	1.748	Yolanda Vaquero	RT @stratesys: #PeopleAnalytics by @stratesys proporciona a los equipos de RRHH datos clave, completos y seguros para tomar decisiones ágil...	WeakPositiveSentiment	ágil	8
25	12/11/2018	1.750	Yolanda Vaquero	RT @stratesys: Este fin de semana hemos estado en #Almadén apoyando a la Asociación de Antiguos Alumnos de la @Esc_Ing_Almaden y al @aytoal...	WeakPositiveSentiment	apoyando	6

Figure 119: Social Media Dataset